

**PREVENTIVE ACTIONS AGAINST MALARIA  
A STUDY OF FACTORS INFLUENCING THE USE AND  
RE-IMPREGNATION OF BED NETS IN HIGHLAND  
VILLAGES IN TANZANIA**

**Omari Yahaya Chambo**

**A thesis submitted to the Faculty of Medicine,  
University of Oslo as partial fulfilment for the degree  
Master of Philosophy in International Community Health**



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Co-supervisor: Kåre Moen  
Co-supervisor: Jan C. Frich**

**Oslo, June 2002**

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# SUMMARY

## ***Preventive actions against malaria – a study of factors influencing the use and re-impregnation of bed nets in highland villages in Tanzania***

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Malaria is one of the most challenging problems in the tropical parts of the world, causing about 1.5 to 2.7 million deaths annually. Ninety percent of these deaths occur in Sub-Saharan Africa and 5% of children die from the disease before reaching 5 years. Malaria is responsible globally for 500 million clinical cases and represents a public health problem for 2.4 billion people. People living in lowland areas, where malaria is common, acquire some degree of immunity against it due to frequent exposure. In the highland areas, however, people don't have immunity against the disease. If malaria is introduced to such a highland area, people are at a higher risk of getting serious malaria and epidemics (highland malaria). The spread of chloroquine-resistant *Plasmodium falciparum* throughout the African continent has stimulated a search for alternative technologies that may play a role in the malaria control strategy. Insecticide treated nets have been clearly proven to reduce transmission, morbidity and mortality rates of malaria in many high-endemic malaria countries. Studies have shown that use and re-treatment of bed nets is relatively uncommon in many communities, but there is limited information about the reasons behind this, especially in areas where malaria has recently been introduced.

The objective of this study is to describe factors influencing the use and re-impregnation of bed nets in an area where malaria has recently been introduced.

This was a cross-sectional study, conducted in three highland villages in Tanzania from September to November 2001. The study consisted of two methods. First, a quantitative household survey was conducted; thereafter 12 informants took part in a qualitative inquiry using semi-structured interviews. The quantitative survey used a two-stage stratified sampling procedure in which 303 households - 100 without bed nets all, 100 with untreated bed nets and 103 with treated bed nets - were identified, and the heads of households interviewed. A survey team consisting of 3 persons conducted the interviews. A pre-tested questionnaire was used to interview the subjects at their homes. Finger pricking was used to obtain blood samples, which were examined for malaria parasites. Data analysis was done using SPSS for Windows, version 11.0. Chi squared ( $\chi^2$ ) or Gamma tests were used for analysis of categorical data, T-test was used for numerical data in two groups at a time and odds ratios were used to measure the strength of the association between independent and dependent variables. The level of significance was set to  $P < 0.05$  at 95% CI. In the qualitative part, a purposeful sampling approach was used to select informants. Hand-written notes were taken during the interviews. The analysis started during the data gathering. Later, the material was read through in order to identify common themes, code parts of the text, identify similarities and generate concepts.

It was found in this study that households with treated bed nets had significantly younger household heads (mean age 32.71 years) than those with untreated (36.72 years) and no nets (42.10 years). Heads of households with treated bed nets had a significantly higher overall level of knowledge about malaria, bed nets and insecticides - with an average score of 26.97 out of 29 knowledge questions (93%) - than households with untreated bed nets (83%) and without bed nets (73%). They were also significantly more literate (98% vs. 75% and 55%, respectively), and had



spent more time in school (7.0 years vs. 4.5 and 3.3 years, respectively). Households with treated bed nets had a much higher average income per person per year (Tshs. 69,499) than households with untreated (Tshs. 29,773) and no nets (Tshs. 23,372), and the differences were significant. A higher proportion of the households without bed nets had heads who felt that insecticides were expensive (67%) than households with untreated (49%) and treated bed nets (18%). These findings were statistically significant. Almost all of the households with treated bed nets (99%) had heads who believed that insecticides have no side effects, as compared to 85% of household heads with untreated, and 76% of households without, bed nets. Again, the differences were statistically significant. Almost all households with treated bed nets had heads who indicated that insecticides were available in their villages (99%), as compared to 78% of households with untreated nets and 63% of households without bed nets. These differences were statistically significant. There were also significant differences regarding the perception of insecticides. All household heads with treated bed nets felt that insecticides help “very much” in the prevention of malaria, as compared to 95% of households with untreated bed nets and 83% of households without bed nets. Thirteen percent of households without bed nets and 4% with untreated bed nets said insecticides help to prevent malaria to “a certain extent”.

The qualitative part of this study explored lay people’s own understandings of these issues. It seemed clear that many people perceived malaria as a major health threat in their villages, and they thought that the seriousness and complications of the disease were the cause of their low economical status. The majority believed that malaria was caused by mosquito bites and that a lack of use of treated bed nets and a lack of destruction of mosquito breeding sites contributed to it. Many people knew how malaria could be transmitted and prevented, but some people did not seek medical

treatment early due to social and local traditions and beliefs. Many people perceived the use of insecticide treated bed nets as an effective way of preventing malaria, but some believed that insecticides could cause harmful effects to human beings. Many informants said that people do not treat their bed nets because they don't have enough money, and half said that they fear side effects of insecticides. Some said people do not treat their bed nets because they don't understand very well how insecticides could prevent malaria and because they don't see mosquitoes in their hamlets, especially during the dry season. Only one informant said the reason was that sometimes insecticides are not available in his village.

This study concludes that low levels of knowledge about malaria, bed nets and insecticides, unaffordability of insecticides, unavailability of insecticides, misconceptions about the effectiveness of insecticides, and myths about side effects of insecticides are associated with low rates of use and re-treatment of bed nets with insecticides. Younger persons seem to adapt to nets and insecticides significantly better than older persons.

It is recommended that the designing and implementation of ITN programs, should consider all the factors associated with the use and re-treatment of bed nets. A joint effort from a combination of different disciplines and sectors is needed to overcome these obstacles. Behaviour Change Communication (BCC) activities should be designed in such a way that they would reach the entire population in the area, but special efforts should also be considered in order to reach the less beneficial groups who are the majority without ITNs. Innovative ways of reaching poor households should be explored. Income-generating projects should be considered in these villages since the purchasing power is so low. The price of bed nets and insecticides should be

made affordable through subsidisation especially in areas where malaria has recently been introduced. Different types of colours, sizes and types of bed nets should be made available to satisfy the preferences of the customers. Several different sales points of bed nets and insecticides should be considered to maintain the availability. Any big construction project in developing countries should include a health impact assessment and mitigation program like the one that was implemented at the Lower Kihansi Hydropower project in Tanzania.

**Key words:** Malaria, prevention, bed-nets, insecticide treatment, treated bed nets, highlands, Tanzania

## **DEDICATION**

This work is dedicated to;

My wife, Mwanamisi Nyangasa; for your encouragement, missing me for so long and taking care of our family without my accompany

My father; Yahaya Chambo for your moral support and encouragement

My mother; Amina Pazia for your care and encouragement

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# **ABBREVIATIONS**

ACO - Assistant Clinical Officer

AMC - Accelerated Malaria Control

BCC - Behaviour Change Communication

CO - Clinical Officer

C.I. - Confidence Interval

CORPs - Community Own Resource Persons

DMO - District Medical Officer

GNP - Gross Net Product

IEC - Information Education and Communication

IDRC - International Development Research Centre

IHRDC - Ifakara Health Research and Development Centre

IRS - Indoor residual house-spraying

ITN - Insecticide Treated Nets

MOH - Ministry of Health

MUAJAKI - “*Mradi wa Ushirikishwaji wa Afya ya Jamii Kihansi*” The Kihansi  
Public Health Project

NMCP - National Malaria Control Program

NORAD - Norwegian Agency for Development Co-operation

RMO - Regional Medical Officer

SPSS - Statistical Package for Social Sciences

TANESCO - Tanzania Electric Supply Company

TBAs - Traditional Birth Attendants

TRD - WHO special program for Research and Training in Tropical Diseases

VHWs - Village Health Workers

Vs. - Versus

WHO - World Health Organisation



## DEFINITION OF TERMS

Attitude - evaluation judgements, good or bad, about particular objects, issues, persons or any other identifiable aspect of environment

Belief - cognitive link between an objective and an attribute, a perceiver's estimate of the probability that the object possesses that attribute

Confidence Interval - a range of values for a variable of interest constructed such that it has a given probability of including the true value of the variable.

Confounding – a situation in which the measure of effect of an exposure to a risk is distorted because of the association of exposure with other factors that influence the outcome under study.

Cross-sectional study – a study that examines the relationship between disease or health-related characteristics and other variables of interest that exists in a population at a given time

District - administrative part of the region, composed of about 4-5 divisions

Division - administrative part of the district, composed of about 3-4 wards.

Endemic - the continuous presence of an infection in the community

Epidemic - an excess of cases in the community from the normally expected, or the appearance of a new infection

Hamlet - smallest unit in the Government of Tanzania organisation structure

Household - a man, his wife or wives, their unmarried sons and daughters, live-in relatives, servants and aged/senile parents.

Incidence - the rate of new cases per year of a certain condition

Knowledge on malaria - the ability to understand the ways in which malaria can be transmitted and prevented. The known ways of transmission are; - bite by infected mosquito, - from infected mother to foetus, and - through blood transfusion from infected donor.

The relevant ways of prevention are: - destruction of breeding sites (stagnant water), - preventing mosquito bite by using insecticide treated bed nets, insect repellents, insecticide sprays, screened houses, mosquito coils, wearing protective clothing at night, use of prophylactic drugs and early treatment of cases.

Knowledge about insecticide treated nets - the ability to understand how treated bed nets can prevent the transmission of malaria, i.e. the treated bed net repels and kills mosquitoes that come in contact with it.

Knowledge about the process involved in the treatment of bed nets - the degree to which the respondents are aware of factors like; - putting on gloves, - measuring the correct amount of water for mixing the insecticide according to type, - drying the net under shade after washing, and - burying or burning the empty pack of the insecticide after taking out the chemical. Washing a net without re-treatment reduces the efficacy of insecticide. The ideal interval between each new net re-treatment (the existing

brand names of insecticides “Zuia mbu and Ngao”) in Tanzania is after every 3 months.

Malaria - a serious, sometimes fatal, diseases caused by a parasite.

Ngao - (*Swahili word for “Shield”*) brand name of an insecticide for the treatment of bed nets in a tablet form.

Odds - the ratio of the probability of occurrence of an event to that of non–occurrence, or the ratio of the probability that it sometimes is so, to the probability that is not so.

Odds ratio - a ratio of two odds, or cross product ratio relative ratio

P-value - the probability of having observed our data (or more extreme data) when the null hypothesis is true

Perception - the beliefs, insight and awareness a person holds towards something, e.g. his beliefs about the consequences of malaria or the efficacy of insecticide treated bed nets

Power - an ability of the study to detect clinically relevant differences between study groups

Practice - the way in which an individual applies his or her knowledge and attitudes in everyday life, e.g. through activities meant to prevent malaria or take care of a person with malaria.

Prevalence - the proportion of a population that has a certain condition at a specific time

Region - administrative part of the country, composed of about 6 districts

Reliability – an expression of the degree of agreement between repeated assessment of the same by the same or other persons. It pertains to the consistency of the research findings

Social marketing - an approach where the experience and methods of commercial marketing are applied to a product, which has a social benefit, with the main motivation being social improvement rather than financial gain to the marketer.

Study population - a group of people selected for investigation

Survey - an investigation in which information is systematically collected but in which the experimental method is not used

Triangulation - a way of strengthening a study design or the combination of methodologies in the study of the same phenomena or program

Validity - an expression of the degree to which a test is capable of measuring what it is intended to measure

Village - administrative part of a hamlet, composed of about 5 to 8 hamlets

Ward - administrative part of a division, composed of about 5-7 villages

Zuia mbu - (*Swahili for "prevent mosquitoes"*) brand name for both treated nets and single-dose insecticide treatment sachets.

# INTRODUCTION

## Global malaria situation

Malaria is one of the biggest problems in the tropical parts of the world. Malaria is a major threat to health and blocks the path to economic development for individuals, communities and nations. Globally, malaria causes about 1.5 to 2.7 million deaths each year, most of which are in children under 5 years of age and pregnant women. Ninety percent of these deaths occur in Sub-Saharan Africa and 5% of children die from the disease before reaching 5 years. Almost all of these deaths are caused by *Plasmodium falciparum*, one of the four species of malaria parasites in humans. The other species are *P. vivax*, *P. malariae* and *P. ovale*. Malaria is responsible globally for 500 million clinical cases and presents a public health problem for 2.4 billion people, representing over 40% of the world's population in over 90 countries [1].

## Malaria and environmental changes

Human developmental activities contribute to the introduction of malaria to areas, which were previously free of it. Construction and environmental changes brought about by development often creates environments favourable for malaria transmission, exacerbating existing problems and opening the way for devastating epidemics in areas which were previously malaria free, leading to many deaths and profound impoverishment of communities [2].

## Highland malaria

Malaria is a common problem in the tropical lowland areas. Many people living in these areas acquire some degree of immunity against it due to frequent exposure. This is different from malaria-free areas in higher altitudes, where people don't have immunity against it. If malaria is introduced to such a highland area, people are at a higher risk of getting serious malaria and epidemics "highland malaria [3]

## The malaria problem in Tanzania (NMCP)

### **Demographic indicators**

The Tanzanian population is estimated to be 33.8 million (2000) based on projections from the 1988 census and a population growth rate of 2.8% (1990-1998). Seventy six percent of the population lives in rural areas (1994). Tanzania is a low-income country with a GNP of 210 USD (1998). The expenditure on health as a percentage of total public health was 27.2 (1997). The life expectancy in Tanzania was 48 years (1998), the under-five mortality rate was 123 (1995-2000), the maternal death rate was 770 per 100,000 live births (1998) and access to health care is 93%. Twenty percent of the population is below the age of five, 47% below 15, 49% is between 15-64 years and 4% is 65 years and above (1995). In 1999/2000 the health budget amounted to 10% of total government budget.

### **Epidemiological Stratification**

Malaria continues to be one of the foremost public health problems facing Sub-Saharan Africa, whether one considers malaria-associated mortality and morbidity, or socio-economic impact. Being one of the sub-Saharan African countries, Tanzania is

facing a big burden of malaria. Malaria is highly endemic in most parts of Tanzania and very few areas are free from this disease. There is great variation in the level of endemicity of malaria in the country. This is determined by geographical, human and biological factors. In over 80% of the regions in Tanzania, malaria transmission is stable perennial to stable seasonal. In recent years malaria has spread to new areas, which were, until very recently, free from it. At any rate all Tanzanians are at risk of being affected by malaria because even those who live at high altitudes are apt to contract malaria when they visit low-lying areas. Malaria endemicity is classified as follows:

**Unstable seasonal malaria:**

These are areas where transmission is not more than 3 months in a year. There is little transmission and normally the effects of malaria on the general population are minimal except during epidemics. These include areas at higher altitude about 2000 metres above sea level and temperatures do not exceed 20 degrees Celsius. Usually there are no malaria cases in the general population. However, malaria may occur in epidemic forms when there are environmental and climatic changes.

**Stable malaria with seasonal variation:**

These are areas with intense, but seasonal, transmission from 3 to 6 months of the year where the immunity is insufficient to prevent the effects of malaria on all age groups. These are the plains at higher altitude, with temperatures above 15 degrees Celsius and mean annual vapour pressures of 10-20 millibars. Transmission is intense, but seasonal, producing ill effects in all age groups during the transmission season.

### **Stable perennial malaria:**

Perennial transmission (6-12 months) of high degree, resulting in a considerable degree of immune response in all age groups, but particularly in adults. All regions of Tanzania mainland along the coast extending to as far as 160-240 kilometres inland, with temperatures of 24-32 degrees Celsius year round and mean annual vapour pressures of 26-29 millibars, fall in this category.

### **Major vectors for malaria transmission**

The major vectors of malaria are *Anopheles gambiae s.s.*, *A. arabiensis*, *A. melas* (along the coast) and *A. funestus*. *A. gambiae s.s.* is present in the humid coastal areas as well as on the islands. *A. arabiensis* is found in arid areas and in the epidemic prone districts. *A. funestus* is found in humid areas around permanent water bodies (rivers and lakes).

### **The disease burden**

Malaria affects most severely the most vulnerable groups, that is, children under the age of five and pregnant women. Malaria is the leading cause of mortality and morbidity particularly in children below the age of five years.

### **Some indicators of the burden of malaria (NMCP - 1997)**

The leading diagnosis in outpatients among children under 5 years:	38%
The leading diagnosis in outpatients aged 5 years and above:	32%
The leading cause of death in hospitalised children under 5 years:	31%
The leading cause for admission among children under 5 years:	43%
The leading cause of death in all age groups of hospitalised patients:	19%



## **Malaria control efforts in Tanzania**

Efforts to control malaria in Tanzania are going on under the umbrella of the health sector reform and Roll Back Malaria. In 1998, soon after being elected, the incumbent WHO Director General, Dr. Gro Harlem Brundtland, set-forth The Roll Back Malaria Movement, the goal of which is to halve the burden of malaria in the afflicted countries by 2010, and to further halves it by 2025. Tanzania, being one of the countries with a heavy malaria burden was selected by WHO together with 20 other African countries to plan and implement a programme for accelerated malaria control (AMC). One of the priority areas is improved vector control and personal protection by scaling up the insecticide treated bed nets (ITNs) to the whole country.

## **Malaria problem in the study area**

The malaria vector is thought to have been recently introduced to Ukami, Uhafiwa and Ihimbo villages in Mufindi district of Tanzania, most likely as a consequence of the environmental changes brought about by construction activities at the Lower Kihansi Hydropower plant. These villages are located more than 1000 meters above sea level. There was no access road between the highland, where the villages are located, and a nearby lowland area on the Kilombero plain (a hyper-endemic malaria zone) before the construction of the Lower Kihansi Hydropower plant started, but a road was constructed as part of this large energy sector development project. Human health conditions in the communities surrounding the Kihansi plant were studied before the commencement of the construction activities. Based on the recommendations given in the baseline studies, the Kihansi Public Health Project (MUAJAKI) was established. The main objective of MUAJAKI is to mitigate health impacts caused by the construction of the hydropower plant. MUAJAKI project is

owned by TANESCO, funded by NORAD and managed by NORPLAN A/S. The project is implemented in close collaboration with the district health authorities in Kilombero and Mufindi.

### **Marked increase in highland malaria**

Unpublished reports from the malaria monitoring studies conducted in the area by the IHRDC, have concluded that there has been a marked increase of malaria among people who have not left their villages compared to what it was during the baseline survey, meaning that people have contracted the infections locally. This means that the pattern of infection has changed; initially it was observed that those who had malaria infection had a recent history of travelling to the endemic malaria area in the lowland. At the moment in the highland villages, malaria infects almost equally those who have travelled to endemic malaria areas (in the lowland) and those who have not left their villages.

In response to this development, the Kihansi Public Health Project started highland malaria mitigation efforts in 1997. The main activities have been training of health personnel and communities' own resource persons, health education, social marketing of bed nets and insecticides for re-impregnation of nets and support to clinical management of malaria in local clinics. The project has supported the distribution of nets in highland villages at highly subsidised price, aiming at providing as many people as possible with nets at an affordable cost with a special focus on social marketing of insecticides for regular re-impregnation of nets in a sustainable way.

# REVIEW OF RELATED LITERATURE

## **Malaria control strategies**

The spread of chloroquine-resistant *Plasmodium falciparum* throughout the African continent has stimulated a search for alternative technologies that may play a role in the malaria control strategy. One of them was the investigation on the protection against bites from adult mosquitoes, including mosquito nets, eaves curtains, window screening and protective clothing [4], [5]. A general finding of this research has been that treatment of netting material or fabric with pyrethroid insecticide greatly increases the protective effect.

## **Efficacy of Insecticide Treated Bed Nets**

The insecticide treated nets have been clearly proven to reduce transmission, morbidity and mortality rates of malaria in many high-endemic malaria countries, mainly in sub-Saharan Africa [6] and India [7]. A meta-analysis of 10 field trials suggested that insecticide-impregnated bed nets are effective in preventing malaria, decreasing the incidence rate ratio by approximately 50% compared to controls without bed nets [8]. Untreated bed nets provide some individual protection against malaria, although not as efficient as that provided by insecticide treated bed nets, which were particularly effective at preventing infection accompanied by high parasitaemia [9]. Insecticide treated bed nets have been proved to be cost effective especially against childhood malaria in The Gambia [10], Ghana [11] and Kenya [12].

In light of these studies, the World Health Organisation (WHO/TDR) and the International Development Research Centre (IDRC) have issued a call for operational research into how best to promote the use of ITNs on a large-scale [13].

### **Distribution and preferences of bed nets and insecticides**

The distribution and preference of certain types of nets and insecticide affect the use and regular re-treatment of the nets. A study conducted in Tanzania on insecticide-treated nets and treatment services indicated that through different distribution channels, good results were achieved especially on purchasing nets. Each outlet was instrumental in making insecticide treated nets available but had little success in the net treatment services. It was mentioned that the treatment of nets with insecticide was generally low. Only 17% of surveyed households already had at least one net at the time of the study. The highest sales of nets and net treatment were during the wet seasons. Overall, people favoured coloured nets because the white fabrics tend to show dirt and smoke more rapidly [14]. The reason for the low rate of treatment of nets with insecticides was not clearly explained, however it was discussed in this study that “In Kilombero district, most of the residents do not have experience with net re-treatment”. This might contribute to the low rate of re-treatment.

### **Social marketing**

The use of ITNs becomes a problem in most of areas because people might not know the importance of using them, the products might not be available, or people may not be aware of how good the product is in terms of efficacy, durability and safety. If people are not well equipped with knowledge about this, they remain with myths on the products. Distribution of bed nets and insecticides through a social marketing

system contributes to overcome these barriers. Social marketing systems bring nets to the community and address issues like knowledge, quality of a product, and availability at reasonable prices as the system is not after profit. This may contribute to the use and re-treatment ITNs and therefore to reduce malaria morbidity and mortality. A recent study conducted in a malaria endemic area in Tanzania on the impact on malaria morbidity of a programme supplying insecticide-treated nets in children under 2 years of age, showed that insecticide-treated bed nets had a protective efficacy of 62% on the prevalence of parasitaemia, and 63% on anaemia. The ownership of nets in this social marketing program increased rapidly (whether treated or not treated) from 58% to 83%, and treated nets from 10% to 61%, in the three years' study period, indicating rapid uptake of the socially marketed treated nets. This study concluded that nets treated with insecticide have a substantial impact on morbidity when distributed in a public health setting [15].

### **Acceptability of insecticide treated bed nets**

The acceptance and use of insecticide treated nets is influenced by a number of factors. A study conducted in Ghana on acceptability of impregnated nets indicated that, although insecticide impregnated bed nets were accepted and used because they provided protection from mosquito bites, seasonal factors, patterns of use and questions of cost were key factors likely to influence the dissemination and effectiveness of bed nets. The use of bed nets was uncommon before the start of the trial, with only 4% of the compounds reporting that they had at least one bed net. No one refused the nets provided free by the project, but only 25% of the people slept on wooden beds, and 3% on bed made from mud. The majority of the people (72%) slept on mats. People quickly adapted to the bed nets, 97% hung the bed nets correctly over

their beds or mats. Use of bed nets was highly seasonal, almost all recipients used their impregnated bed nets in the rainy season (99%), the period of high mosquito density, and 20% used them in the dry seasons, the period of low mosquito density. Most people (70%) used bed nets to prevent mosquito bites and 27% to have good night-sleep. Amongst all bed nets recipients (98.9%) were ready to replace them if they were badly torn, but only 67% and 78% were prepared to pay for replacement of bed net and insecticides, respectively, although they had experienced the benefit of insecticide-impregnated bed nets for 2 years [16]. Seasonal factor was reported in a similar study [17]. A study conducted in Tanzania has shown that people who had previously used bed nets, accepted insecticides quickly, because they noticed a change when starting to treat their bed with insecticides, compared to those who had not used bed nets before [18].

### **Willingness to pay for insecticide treated bed nets**

When one considers treating a net with insecticide, one of the issues involved will be the cost involved and the willingness to pay this cost. A study conducted in Nigeria on the willingness to pay for the re-treatment of nets with insecticides showed that most households were willing to pay for annual insecticide re-treatment, but that they did not feel they were able to do so. The proportion of those willing to pay ranged from 79% to 91%. This suggests that people may be willing to pay for re-treatment of nets, and that the difficulty may lie on other aspects of the implementation. It was mentioned that one possibility would be a community-based insecticide treated nets re-treatment program. It was discussed in this study that considerations of costs of ITN re-treatment might influence the willingness of people to pay. Beside this general

consideration, other factors such as reduction in number of malaria episodes, mosquito nuisance, reduction in work and school days lost could influence this [19].

### **Charging for insecticides**

A study conducted in Gambia on the impact of charging for insecticides showed that, in the villages where re-treatment services were provided free, 77% of nets were treated with insecticides. In contrast, in villages where charges were made, the coverage was only 14%. During the first year of the national insecticide impregnated bed net programme, mortality in children was significantly lower in villages where insecticide was provided free than in the control village. Introduction of a charge for insecticides into the first group of villages and the provision of free insecticide later abolished this difference. Lack of fund was cited by heads of household during the post treatment survey, as the main reason why could not produce cash needed. It is possible that reduction in costs might have substantial effect on coverage of re-impregnation [20].

### **Social and cultural factors related to re-treatment of bed nets**

A related study conducted on the social and cultural factors affecting rates of regular re-treatment of mosquito nets with insecticide in Bagamoyo district, Tanzania showed that rates of re-treatment dropped significantly when payment for the insecticide was introduced. When the insecticide re-treatment services were provided free, the re-treatment rates for the three villages were 68.3%, 59.3% and 77%. Later, when a fee was introduced, the rates dropped to 30.0%, 20.5% and 55.0 %, respectively. All respondents in the initial set of interviews felt that the insecticide worked or had a beneficial effect. Four principal reasons were cited for low rates of re-treatment of

nets:- The fee charged for re-treatment, the inconvenience of the re-treatment, many nets not in use, and concerns about the toxicity of the insecticide. Concerns about toxicity were greatest for children as respondents thought that these are weaker than adults. Economical factors mentioned to affect rates of re-treatment were variation of getting money, lack of control of household budget and alcohol consumption by some young migrant men. Some women cited lack of control over the household budget as a reason for not re-treating their nets. Some people stored (in parks) their nets waiting for high-density mosquito periods, some said it was very hot to use nets during the hot period of the year [21].



# OBJECTIVES OF THE STUDY

## Rationale

Previous studies seem to indicate that knowledge, attitude and practices about malaria transmission and prevention, availability, cost and beliefs on the efficacy and side effects of insecticides, seasons and general perception of malaria and insecticide treated bed nets influence the use and re-impregnation of bed nets. Most of the studies and experience gained in relation to factors influencing use and re-impregnation of bed nets are from lowland areas where malaria is endemic. As few studies have been carried out on the causes of lower rate of bed net re-impregnation in areas where malaria has recently been introduced, and taking into consideration that people in these areas are at high risk of serious malaria and epidemics, more studies are needed.

In order to understand the main factors influencing whether or not people re-impregnate their bed nets in an area where malaria has recently been introduced, and to describe how the local communities have responded to a new epidemiological situation, the present study was conducted.

## Hypothesis

Lack of knowledge on malaria transmission and prevention, misunderstandings about the role of insecticide treated nets in malaria prevention, myths about the side effects and efficacy of insecticides, unavailability of insecticides and cost of insecticides lead to lower rates of use and re-impregnation of bed nets.

The present study addresses the following objectives with this hypothesis in mind;

## **Main objectives**

To describe factors affecting the use and re-impregnation of bed nets in an area where malaria has recently been introduced.

## **Specific objectives**

To compare people's knowledge, attitudes and practices regarding malaria transmission and prevention between those who have no nets, untreated nets and with treated nets.

To investigate people's understanding, attitudes and practices regarding insecticide treated bed nets

To investigate people's perception of the effects, side effects and efficacy of insecticides

To investigate the availability and affordability of insecticide for treating nets

To investigate malaria illness episodes and the presence of malaria parasites

# METHODOLOGY

## Characteristics of the study area and population

### **Location of the study area**

The present study was conducted in a rural area consisting of three highland villages in Tanzania. The United Republic of Tanzania lies between 1 and 12 degrees south of equator and between 30 and 40 degrees east with a geographical area of 945,050 square kilometres. Administratively Tanzania mainland is divided into 20 regions (See figure 1) with a total of 114 districts. Each district is divided into 4-5 divisions, which in turn are composed of 3-4 wards. A ward is typically composed of 5-7 villages. The villages are further divided into hamlets (about 5 to 8), which are the smallest units in the government organisational structure. The three study villages (Ukami, Uhafiwa and Ihimbo) are located in the Mufindi district of Iringa region in the southeastern highlands of Tanzania. (See figure 2). These villages are situated more than 1000 metres above sea level. They are about 120 kilometres from the district headquarter, and about 600 kilometres from the capital city of Tanzania - Dar-es-Salaam. These villages are within the Kihansi catchment management area (see figure 3).

## Map of Tanzania

The arrow points to the location of the study area



Figure 1

## Map of Iringa and Morogoro regions

The study area in Mufindi district of Iringa region has been circled.



Figure 2



### Map of the Kihansi catchment area and the three study villages

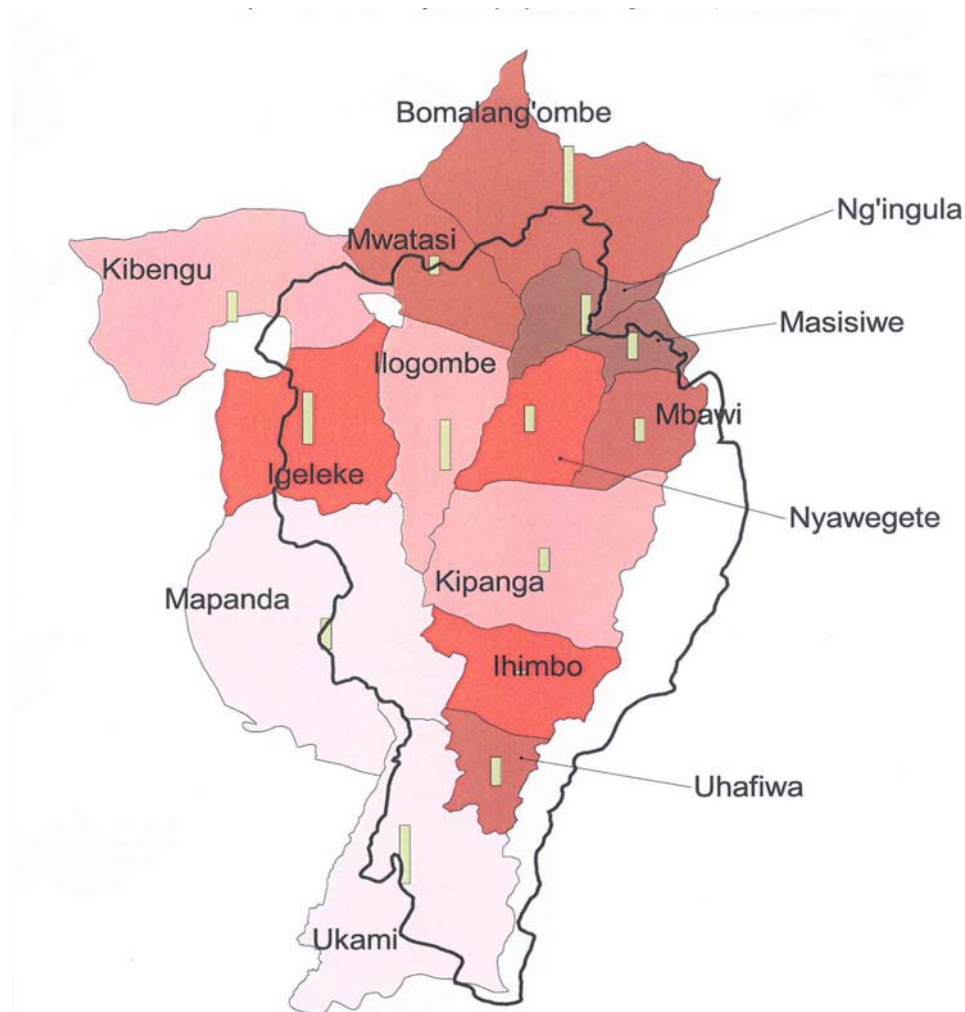


Fig. 3

### Background information about the target population

The area under study had a total population of 5,917 people living in 1179 households (data from a Census carried out in 1999 and reports from a Demographic Surveillance System up to August 2001). The total population in Ihimbo village was 1545 persons living in 5 hamlets and 362 households. Uhafiwa village had a total population of 1425 people living in 3 hamlets and 224 households, and Ukami village had a total population of 2947 people living in 3 hamlets and 593 households. The population is generally stable with temporary shifting to the nearby villages during the farming periods of the year. There are two main tribes in these villages (*Hehe* and *Bena*),

which are the major and more dominating tribes in Mufindi and Iringa district and region respectively. These people speak their own local languages (*kihehe* and *kibena*) and Swahili, which is the national language.

### **Socio-economic status**

The three study villages have similar socio-economic conditions. Almost all people in these villages are small-scale peasants growing maize, beans and millet as food crops. The houses of these people are of low standards, mostly constructed by mud walls, thatched with grasses and small in size. There is almost no permanent source of employment in the villages.

### **Health facilities**

There are two government dispensaries in this area. One is located in Uhafiwa village. This is an old unit, but at the time of the study it was undergoing rehabilitation by the villages with support from the Kihansi project. The other dispensary is located in Ukami village. This is a new facility, which was constructed two years back by the villagers themselves with support from the district council and the Kihansi project. Each dispensary is staffed with an assistant clinical officer as the in-charge of the day-to-day operation of the unit and one nurse assistant. These two dispensaries serve people in all the three study villages. The government, through the district council, operates both dispensaries. There is a missionary hospital about 60 kilometres away, and a district hospital about 120 kilometres away from these villages.

### **Community's own resource persons (CORPS)**

The three villages had several CORPS: village health workers, malaria assistants, traditional birth attendants, peer health educators, community distributors of family planning, traditional healers, artisans for construction of VIP latrines (Ventilated Improved Pit latrines), sales persons for bed nets, insecticides and condoms, and primary health care committees. There were additional health personnel resources on the ward levels (ward health assistants).

### **Health-related organisations/projects**

The Kihansi Public Health Project (MUAJAKI) is the existing health project in these villages. MUAJAKI is basically dealing with disease prevention and health promotion, mostly in the field of STD/HIV control, malaria control, environmental sanitation and reproductive health.

### **Study population**

The study population were all people aged 18 years and above. This age group was selected because it consists of people assumed to be responsible for net re-treatment in the local setting. The language of communication in this study was Swahili, the national language of Tanzania.

## **Methods**

### **Study design and sampling procedure**

This study used a mix of quantitative and qualitative methods. The aim of using two methods (Triangulation) was to strengthen and increase the validity of the study [22].



## **Ethical considerations**

The ethical clearance of this study was obtained from the Tanzanian Ministry of Health (see appendix 1). The Norwegian ethical committee approved a detailed protocol for the study (see appendix 2). Informed consent was obtained from the district medical officer, the respective village leaders and the subjects under study after they had read the consent-form (see appendix 3). Participation in this study was optional, and the participants were free to stop their participation if they changed their mind during the process.

## **Part 1: Quantitative part of the study**

This was a combined descriptive and analytical cross-sectional study conducted from September to November 2001. This method was chosen because it costs less and was regarded as more feasible in the relatively short time available than other study designs. Longitudinal studies, for example, need a lot of time and would not have been feasible. The potential disadvantage of this approach was that the information gathered might not have been detailed enough, due to insufficient in-depth descriptions of the phenomena under study. However, this problem was taken care of by using two methods, this and a qualitative survey (Tringulation).

## **Sample size**

In order to test the hypothesis and analyse factors influencing the use and re-treatment of nets, 303 subjects from 303 different households were interviewed. 100 subjects were from households without bed nets, 100 from households with at least one bed net, but without a history of re-impregnating nets, and 103 subjects were from households where at least one bed net had been re-impregnated in the past. The

calculation of the sample size was based on some assumptions related to the probable impact of knowledge, ability to pay, perception and availability of insecticides on the use and insecticide treatment of the nets. Sample sizes were calculated in order to achieve 80% power and 95% confidence intervals comparing proportions in a two step way between the 3 study groups, one without bed nets, one with untreated bed nets and one with treated bed nets.

## **Sampling**

The 303 people that actually took part in the study were selected randomly in a two-stage process. In the first stage, a stratified random sampling method was used to select households from three different groups:- (1) households without any bed nets, (2) households where at least one bed net was in use, but where no bed net had ever been re-impregnated, and (3) households where at least one bed net had been re-impregnated in the past.

To achieve this, we first visited the three villages and collected bed net registration forms from village health workers and malaria assistants. The forms had the names of the village, the hamlet and the heads of households owning nets, as well as the date when a net was bought, the name of the sales person and the date of impregnation. Village health workers and malaria assistants had filled these forms monthly to update the existing list of people who had bought and treated nets. Usually the forms were sent to the Kihansi Public Health Project office monthly in order to update the existing malaria monitoring database. Unfortunately by the time we wanted to start the study, the forms had not yet been sent, and that's why we went to pick them.

After collecting the forms we updated the existing lists, which were available in the MUAJAKI data base, and separated households with nets that had never been treated and households with nets that had been treated at least once in the past. A total of 426 households with bed nets that had never been treated, 103 with at least one bed net that had been treated at least once in the past, and 650 households without bed nets were delivered from the main list. As the number of the households that had treated bed nets (103) was very close to the planned group size (100), we interviewed all. Random sampling was therefore only done in the groups of households with untreated bed nets and no nets. The sampling was done using the random number generator in a computer-spread sheet. In the second stage, a simple procedure was used to randomly select either the male head of household or the female housewife as the respondent. This was simply done by tossing a coin.

## **Respondents**

The respondents of this survey were 303 people that were either a (male) head of household or a (female) housewife selected by stratified random sampling.

## **Criteria of inclusion and exclusion**

All persons that were not either a male head of household or a female housewife were excluded from the study because they were assumed not to be responsible for the treatment of nets in the local setting.

People who did not like to participate were excluded (only one person refused to be interviewed)

Seriously sick people were excluded if they could not manage to communicate with the interviewer (one person was terminally ill and could not manage to participate)

If a person was not encountered after three consecutive visits to his/her house, he was discarded (9 persons were missed in this way).

Re-sampling was allowed in the respective groups only in order to replace discarded heads of households because of exclusion criteria.

## **Data collection**

### **Interview team**

The interview team consisted of three interviewers including the master student, Omari Chambo. Two interview assistants were recruited before the interview and trained in interview technique. The training included the use of role-plays. The two assistants were recruited from the Kihansi Public Health Project staff, as they knew the area, the language and the culture of the people under study, and also had experience with data collection. In addition to their relevant experience the two assistants were selected on the background of personal interest and willingness to take part in the study as interviewers.

### **Pre-testing of questionnaire**

The questionnaire was pre-tested before the interview. This was done in a village (Mapanda), which was not part of the survey area. A total of nine persons were interviewed in the pre-testing exercise. Three of them came from households without bed nets, three from households with at least one net that had never been treated, and three from households with at least one net which had ever been treated in the past.

After pre-testing, the three interviewers discussed the questions according to the responses, and some modifications were done to the wording, content and coding of responses.

### **Survey instrument**

A structured interview questionnaire (see appendix 4) with the most common answers listed on the form with numerical codes for data entry purpose was used. The format of the questions were Yes/No, Agree/Disagree and open-ended with the interviewer recording the first response given. The interview was divided into 6 general sections; (1) Identification and social demographic information, (2) Use of bed nets (3) Knowledge on malaria transmission and prevention, (4) Health education sessions, (5) Knowledge, Attitude and Practices related to use and re-treatment of bed nets with insecticides, (6) Malaria illness episodes.

Subjects were visited at their homes. An observation checklist (see appendix 5) was used to confirm the presence of radios, beds, bed nets, mattresses, mats and containers that could be used for re-treatment of nets. Blood samples were taken under sterile conditions by finger pricking in order to assess whether there were malaria parasites present. Blood slides were stained with Giemsa in one of the two village dispensaries, and stored in slide boxes for some days before they were transported to Ifakara Health Research and Development Centre (IHRDC) weekly for microscopic examination using standard procedures. The results of the examined slides were collected from Ifakara centre on a weekly basis. Positive subjects were provided with free anti-malaria drugs (sulfadoxine-pyrimethamine) in standard doses.

Three Norwegian medical students from the University of Oslo took part in the fieldwork as part of their curriculum. The students were in the field with the interview team for one week and learnt the techniques of taking blood samples by finger pricking and making blood films for microscopic examination for malaria parasites. After one week of fieldwork at Kihansi, the students went to Ifakara Health Research and Development centre for training on how to examine malaria parasites microscopically.

### **Data handling**

After data collection and coding on the questionnaire forms, data were entered into a computer database in the evening of each field day using the Epi Info 2000, a software program developed jointly by the Centre for Disease Control (CDC) and the World Health Organisation. Data were later imported to SPSS (Statistical Package for the Social Sciences) and analysed in Oslo.

### **Data analysis**

Before the analysis, data were cleaned and screened in SPSS for Windows, release 11.0. The chi-squared ( $\chi^2$ ) and gamma tests were used for analysis of categorical data. This was done by cross tabulating the independent and dependent variables in the three groups to get the differences of the factors in all groups. T-test statistical method [23] was used to analyse numerical data for pairs of groups at a time. The level of significance was set to  $P < 0.05$  at 95% confidence intervals. Odds ratio was also used to measure the strength of the association between the independent and dependent variables. These methods facilitated the comparison of the associations in the three groups of households regarding the different factors influencing the use and

re-treatment of nets. Some of the tables and graphs have been included in this report in order to describe the results of the present study.

## Part 2: Qualitative methodological approach

### **Methodological approach**

The aim of the qualitative part of this study was to get deeper and more detailed information about issues concerning health, sickness and re-impregnation of bed nets in the study villages. The goal of qualitative research is normally to obtain qualitative descriptions of the life and world of subjects with respect to the interpretation of their meaning [24].

The same approach was used in other studies investigating factors influencing the re-impregnation of bed nets in Tanzania [21], [18].

### **Sample size**

There are no standards for sample size in a qualitative inquiry, and I chose to limit the number of informants to twelve, due the time and resources available. The informants were selected by purposeful sampling approach.

### **Informants**

The informants of this study were twelve people who were particularly knowledgeable and articulate people. These informants had taken a leading role in preventing malaria in their respective villages in some way or another. They were also interested in expressing their views on health and other development issues. One of

them was a village health worker and another one was a malaria assistant. The rest were individuals who had no formal role in preventing malaria, but who had an interest in working with and discussing the issue. The interviewers noticed some of the informants during the quantitative data collection. These were discussed among other identified people in the selection meeting before they were finally chosen as informants.

### **Selection of informants**

The informants were selected among those who took part in the quantitative interview of this study and they were chosen by a purposeful sampling approach [25]. Village health workers and malaria assistants of the respective villages, myself and the two research assistants took part in the selection of the informants. We started by giving information to the village leaders that we would like to have four persons in each village who would give more information about malaria and re-impregnation of bed nets. The village leaders told us to discuss this with the village health workers and malaria assistants and asked them to take part in the selection.

Four informants belonged to households which had no nets, five were from households owning nets but having no history of net treatment, and three of the interviewees were from households which had at least one net which had ever been treated with insecticides in the past. Half of the informants were females.

I got the impression that the informants saw this interview as an opportunity to air their concerns and to ask a support on solving malaria problems in their villages, notably in the form of health education and availability of affordable treated bed nets.



## **Data collection**

The method used for data collection was open-ended semi-structured interviews. The interviews were done according to an interview guide (see appendix 6) addressing issues concerning knowledge, perceptions, attitudes and practices about malaria and the use of bed nets treated with insecticides. This method provided me with a reasonable and efficient means of gaining deeper insight into concrete questions and issues on malaria and the use of insecticides for re-treating bed nets. This method is flexible, easy, cheap and less time consuming than other qualitative methods like participatory observation, which needs much time, and focus group discussions, which need time-consuming preparations. A similar method was also used in a study conducted in Tanzania previously [21].

Interviews for this part of the study were conducted a week after the quantitative data collection in November 2001, in the dry season of the year. The research student, Omari Chambo, conducted the interviews. The informants were told about the study a week before and asked if they would like to take part in the in-depth interview. All selected informants agreed and showed interest of participating. Appointments were then made with all informants and later interviews were conducted in their homes. As I did not know the locations of these informants, a village health worker or malaria assistant escorted me to their homes. This was followed by introduction, in which I introduced myself as a student conducting research with the aim of investigating thoughts, opinions, knowledge and attitudes that could be of importance to the health situation in the area. Some of the informants remembered me as I worked in this area four years before coming to join this course. I also remembered a few of them.

The interviews took place in the participants' homes. I gave a brief explanation of the aim of the study and confidentiality-related issues. After briefing, inquiry of information through the use of the interview guide commenced. Probing questions were posed during the interview depending on the responses from the informants. Some common probing questions were; Could you please tell me why many people do not destroy breeding sites for mosquitoes? How do people destroy mosquito-breeding sites? Why do many people not use bed nets? What kind of side effects do people think the insecticides might have? How long normally people stay when visiting the low lands? Are there more reasons than what you have told me?

At the end of the interview, debriefing was carried out. Generally the interviews were conducted in a harmonious and friendly atmosphere, although in some places there were interruptions from other members of the family or I had to wait for the informants to accomplish some of their activities at home. This happened mostly to female informants. Each interview took about three hours to be completed.

### **Data handling and processing**

During the interview, data were recorded by taking hand written notes. Some informal abbreviations were used. Some quotations were read back to informants who were asked if what had been written was exactly what had been said. This was done mostly with particular important information. Writing notes was interesting and informants felt free to give information. It is my belief that it created a more friendly and natural way of conversation than it would have been if an electronic device like tape recording had been used.

After collection, the quality of the data was checked out and gaps filled in. After being certain that all information was in place, I read through the notes and typed the information into the computer ready for further analysis.

The weakness of written notes is that one may miss some information, which would not be missed when using a tape recorder. I tried to account for this by reading back some quotations, asking if that was what informants had said. I also reviewed the notes several times.

### **Data analysis**

Although some ideas of analysis started during data gathering, the formal analysis was done later. This started by reading through the material to get a general impression and identify common themes. After reading through, the material was translated into English and coding of parts of the text followed. After coding, the relation of the coded parts was analysed in order to identify the similarities or differences between them. This was followed by generation of concepts that were used to organise the presentation of results. As the use of this information is to give a general impression of the subject's views and to strengthen the quantitative part of this study, the material was condensed in a meaningful manner.

### **Reliability**

This was achieved through pre-testing of the questionnaire in the pilot study and detects the inconsistency from the three interviewers. Interviewers were instructed to avoid leading questions and to report exactly what the respondents said. The results of this study were consistent with results reported in other related studies.

**Validity**

To increase the validity of this study, two methods (triangulation) were used. These were face-to-face interviews using a structured questionnaire, and a qualitative inquiry using semi-structured informant interviews. In addition to this, the informants of this study were randomly selected. This helped to control selection bias and confounding. The questionnaire was translated from English to Swahili and pre-tested and skilled interviewers were used as interviewers. The observation of some items like radio, beds and mattresses were consistent with what the respondents said. This has also increased the validity of this study.

# MAIN FINDINGS - QUANTITATIVE STUDY

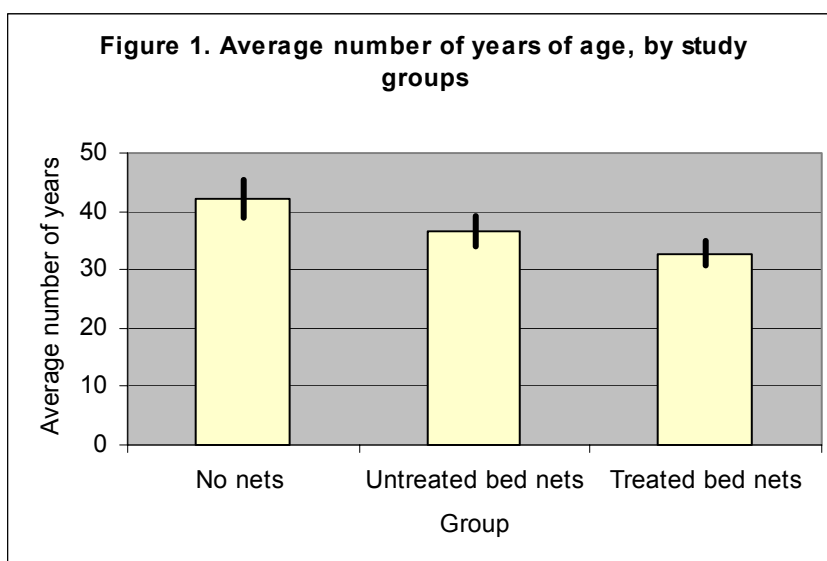
## Demographic variables

### Sex

Males constituted 53% of the 303 heads of households that were interviewed. Fifty eight percent of the households with treated bed nets had male heads, the corresponding proportion was 53% for households with untreated bed nets and 48% for households without bed nets. Flipping a coin was used as a simple second stage stratified random sampling procedure to select either the male or female head of the household to be interviewed. Equal proportions of males and females were therefore expected because selection was a random sampling.

### Age

As shown in table 1 and figure 1, there was a significant association between the age of a household's head, and the use and re-treatment of bed nets. Younger persons in the surveyed communities, where malaria was a relatively new challenge, seemed to



have adapted more easily to the use of bed nets than older persons. Households with treated bed nets had

younger household heads (mean age 32.71 years) than those with untreated bed nets (36.72 years) and those without bed nets at all (42.10 years).

**Table 1. Average age of household head, by study group (n=303)**

	Group		
	No bed nets (A)	Untreated bed nets (B)	Treated bed nets (C)
Average age in years	42.10	36.72	32.71
95% Confidence interval	38.79, 45.41	34.15, 39.29	30.60, 34.81

When comparing two groups at a time, P-values were; group A Vs. B P=0.012; group B Vs. C P=0.017; group A Vs. C P<0.001

Table 2 shows that the largest proportion of the interviewed heads of households (24.8%) was in the 25-29 years age category. The mean age (not shown in this table) of the interviewed heads of households was 37 years, the median was 33 years and mode was 28 years.

**Table 2. Age groups of interviewed heads of households**

Age group in years	Frequency	Percent	Cumulative percent
15 - 19	5	1.7	1.7
20 - 24	39	12.9	14.5
25 - 29	75	24.8	39.3
30 - 34	43	14.2	53.5
35 - 39	36	11.9	65.3
40 - 44	27	8.9	74.3
45 - 49	20	6.6	80.9
50 - 54	15	5.0	85.8
55 - 59	12	4.0	89.8
60 - 64	8	2.6	92.4
65 - 69	13	4.3	96.7
70 - 74	4	1.3	98.0
75 - 79	3	1.0	99.0
80 - 84	1	.3	99.3
85 - 89	2	.7	100.0
Total	303	100	

### **Number of people living in a household**

There was no clear association between the number of people living in a household and the use and re-treatment of bed nets with insecticides (n=303). Households with

untreated bed nets had slightly higher average number of residents (4.75) than households with treated bed nets (4.41) and for the households without bed nets (4.38). This difference was not statistically significant.

## Education and occupation

### Literacy

Households with literate heads were more likely to use and re-impregnate bed nets than those with illiterate household heads. Table 3 shows that 98% of the households with treated bed nets had heads who knew how to read and write Swahili, as compared to 75% of the households with untreated bed nets and 55% of the households without any bed net at all ( $P<0.001$ ).

**Table 3. Literacy among household heads, by study group (n=303)**

Do you know how to read and write Swahili?	Groups		
	No bed net	Untreated bed net	Treated bed net
Yes	55	75	101
No	45	25	2
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	2.46	(1.35, 4.47)	$P=0.003$
Treated nets vs. untreated	16.83	(8.87, 73.28)	$P<0.001$
Treated nets vs. no nets	41.32	(9.65, 176.84)	$P<0.001$

### Schooling

There was a remarkable difference between the three groups regarding the household heads' responses of been to school. As shown in table 4, a high proportion of the interviewed heads of households with treated bed nets (97%) had been to school, compared to 76% of those with untreated bed nets and 56% without bed nets ( $P<0.001$ ).

**Table 4. Whether the household head had ever been to school or not, by study group (n=303)**

Have you ever been to school?	Group		
	No bed net	Untreated bed net	Treated bed net
Yes	56	76	100
No	44	24	3
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	2.49	(1.36, 4.56)	P=0.003
Treated vs. untreated nets	10.53	(3.06, 36.26)	P<0.001
Treated nets vs. no net	26.19	(7.78, 88.22)	P<0.001

As shown in table 5 and figure 2, there was an association between the number of years the household heads had attended school and the use and re-treatment of bed nets. On the average, households with treated bed nets had heads that had been going to school more than twice as long as the heads of households without bed nets, and over 50% longer than the heads of households that owned at least one untreated bed

net. When

comparing two

groups at a time,

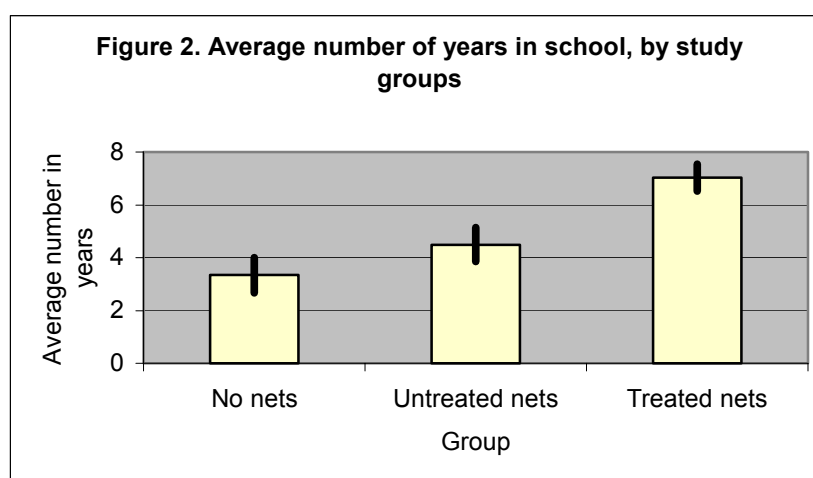
the different, was

significant as

indicated by the

P-values reported

in table 5.



**Table 5. Years of schooling among household heads, by study group (n=303).**

	Group		
	No bed nets (A)	Untreated bed nets (B)	Treated bed nets (C)
Average no of years in school	3.34	4.49	7.03
95% Confidence interval	2.67, 4.01	3.85, 5.13	6.52, 7.54

When comparing two groups at a time, P-values were; group A Vs. B P=0.014; group B Vs. C P=0.001; group A Vs C P<0.001



## Occupation

A higher proportion of the households with treated bed nets (13.6 %), had employed heads than households with untreated bed nets (2%) and without nets (0%) (P<0.001).

**Table 6. Employed household heads, by study group (n=303).**

	Group		
Employment	No bed net	Untreated bed net	Treated bed net
Yes	0	2	14
No	100	98	89
Total	100	100	103

<b>Odds ratios</b>	<b>OR</b>	<b>95% C.I.</b>	<b>P-value</b>
Treated nets vs. Untreated nets	7.71	(1.70, 34.86)	P=0.002

The odds ratio was not calculated between the group of households with untreated bed nets and no net, and between treated and no nets, because there was no employed head of household in the group of households without nets.

The survey area is located in a rural area where most of the people are peasants. As shown in table 7, all of the interviewed heads of households without bed nets and with untreated bed nets were peasants, compared to 92.2% of those with treated bed nets ( $P < 0.001$ ).

**Table 7. Peasant household heads, by study group (n=303).**

	Group		
Peasant	No bed net	Untreated bed net	Treated bed net
Yes	100	100	95
No	0	0	8
Total	100	100	103

The odds ratio was not calculated because all people in two of the groups were peasants.

A higher proportion of households with treated bed nets (5.8%) and of household heads with untreated bed nets (1%) were businessmen than among those without nets (0%) (P=0.012).

**Table 8. Business household heads, by study group (n=303).**

	Group		
Business	No bed net	Untreated bed net	Treated bed net
Yes	0	1	6
No	100	99	7
Total	100	100	103

**Odds ratios**

**OR**

**95% C.I.**

**P-value**

Treated vs. untreated nets

6.12

(0.72, 51.81)

0.06

The odds ratio was not calculated between the group of households with untreated bed nets and no nets, and between treated and no bed nets, because there was no businessmen in the group of households without nets.

## Household economy

### Contribution to the household income

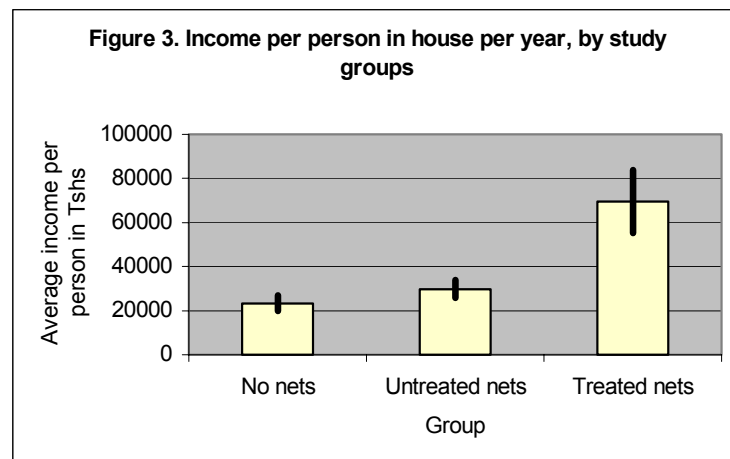
There was no significant association between the percentage of people contributing to the income of a household

and the use and re-treatment of bed nets. All three groups had almost the same average percentages of the people contributing to the household income:

households with treated bed

nets had an average percentage of 59.97, while households with untreated bed nets

had 59.64 and those without bed nets had 58.24.



### Income per person per household

As shown in table 9 and figure 3, there were differences between the three groups regarding the annual per capita income. Households with treated bed nets had a higher average income per person per year (Tshs. 69,499) than households with

untreated bed nets (Tshs. 29,773) and without bed nets (Tshs. 23,372). When comparing two groups at a time, it was shown that the differences in average income per person per year were statistically significant.

**Table 9. Household income, by study group (n=303)**

	Group		
	Without bed nets (A)	Untreated bed nets (B)	Treated bed nets (C)
Average income per person in a household	23372	29773	69499
95% Confidence intervals	19959, 26785	25749, 33797	55365, 83630

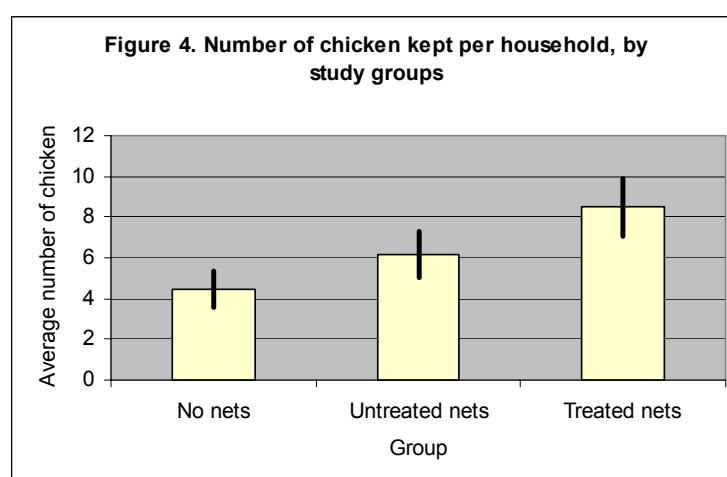
When comparing two groups at a time, P-values were; group A Vs. B  $P=0.017$ ; group B Vs. C  $P<0.001$ ; group A Vs. C  $P<0.001$

### Arable land

Households with untreated bed nets had slightly more arable land (3.66 acres) on the average than households with treated bed nets (3.37 acres) and without bed nets (2.84 acres). Regarding this variable there was no trend of gradual increase from the group of households without bed nets to the one with treated bed nets. In instead, those households with untreated bed nets owned the largest areas of arable land. When comparing two groups at a time it was shown that the differences between households with untreated bed nets and without bed nets ( $P=0.013$ ) and between treated bed nets and without bed nets ( $P=0.005$ ) were statistically significant. The difference between treated bed nets and untreated bed net was not statistically significant ( $P=0.403$ ).

### Chicken kept per household

Table 10 and figure 4 illustrate that wealthier households, as indicated by the number of chicken kept, were more likely to



use and retreat their bed nets compared to those with a lower number of chicken.

When comparing two groups at a time, it was shown that the differences between groups were statistically significant.

**Table 10. Number of chicken kept per household, by study group (n=303)**

	Group		
	Without bed nets	Untreated bed nets	Treated bed net
Average number of chicken in a household	4.45	6.14	8.50
95% Confidence intervals	3.57, 5.33	5.01, 7.27	7.09, 9.92

When comparing two groups at a time, P-values were; group A Vs. B P= 0.020; group B Vs. C P=0.010; group A Vs. C P<0.001

## Having a radio

Radios were more common in households having bed nets. 71.8% of households with treated bed nets owned a radio. The corresponding proportion among household having untreated nets was 47%, whereas only 19% of households without a net had a radio (P<0.001). Again, the impression was that there is a strong association between the household economy and the use of bed nets.

**Table 11. Having a radio, by study group (n=303).**

	Group		
Having a radio	No bed net	Untreated bed net	Treated bed net
Yes	19	47	74
No	81	53	29
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	3.78	(2.00, 7.14)	P<0.001
Treated nets vs. Untreated nets	2.88	(1.61, 5.15)	P<0.001
Treated nets vs. no nets	10.88	(5.63, 21.02)	P<0.001

## Housing

Having a house roofed with corrugated iron sheets is a symbol of being wealthy in the local setting. As found during the observation, all households without bed nets had

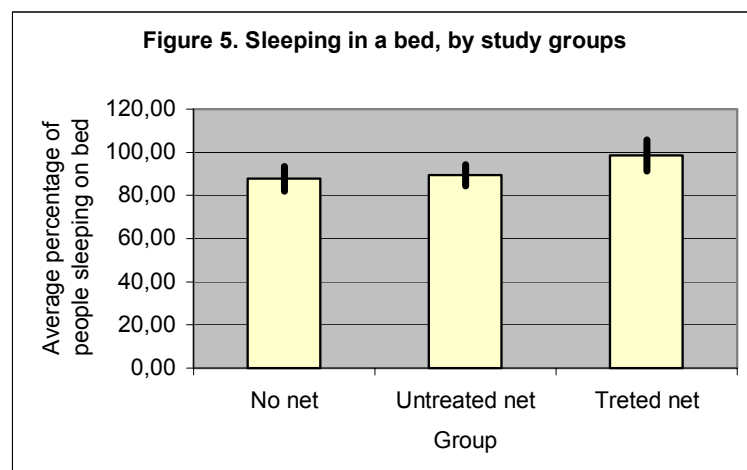
houses that were thatched with grasses, compared to 84% of households with untreated bed nets and 16% of households with treated bed nets ( $P < 0.001$ ). These observational results are consistent with the results of variables of household economy, which showed that households with treated bed nets were wealthier than households with untreated bed nets and without bed nets.

## Sleeping habits

### People sleeping in a bed

Regarding the number of people sleeping in a bed, there was a slight difference between households with untreated bed nets (89.40%) and without bed nets (87.75%), whereas almost all persons (98.59%) in households with treated bed nets slept on a bed. As shown by P-values in table 12, the difference between households in group A and B was not statistically significant, while the differences between group B and C and group C and A were statistically significant.

When observing the presence of beds in households, it was found that the average number of beds per household member in households with treated bed nets was



higher (0.56 beds per person) than with untreated bed nets (0.47) and without bed nets (0.46). When comparing two groups at a time, P values were as follows; Between

group A and B ( $P=0.525$ ), between B and C ( $P=0.014$ ) and between A and C ( $P=0.004$ ).

**Table 12. Proportion of people sleeping in a bed, by study group ( $n=303$ )**

	Group		
	Without bed nets (A)	Untreated bed nets (B)	Treated bed net (C)
Average percentage of people sleeping in a bed	87.75	89.40	98.59
95% Confidence intervals	82.00, 93.49	84.43, 94.37	91.46, 105.71

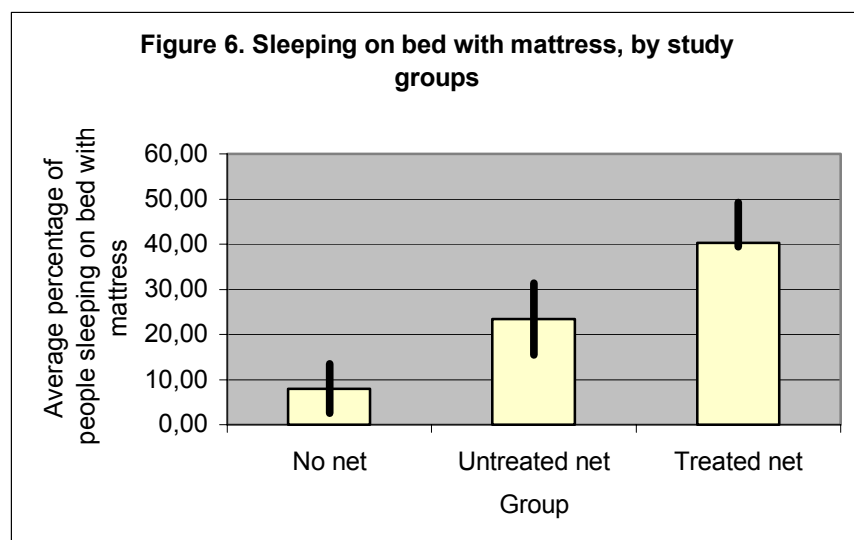
When comparing two groups at a time, P-values were; group A Vs. B  $P=0.666$ ; group B Vs. C  $P=0.037$ ; group A Vs. C  $P=0.020$

### Sleeping in a bed with a mattress

As shown in table 13 and figure 6, there was a difference in the average percentages for the three groups of households when it comes to people sleeping in a bed with a mattress. Households with treated bed nets had a higher average percentage of people sleeping in a bed with mattress (40.31%) than those with untreated (23.39%) and without bed nets (8.00%). When comparing two groups at a time, it was shown that the difference

between households was statistically significant.

The observation that was carried out after the



interviews showed that households with treated bed nets had a higher average number of mattresses per household member (0.26 per person) than households with untreated nets (0.11) and without bed nets (0.04). When comparing two groups at a time, P

values were; Between group A and B:  $P=0.003$ , between B and C:  $P<0.001$ , and between A and C:  $P<0.001$ . There was a trend of gradual increase in the number of mattresses per capita from households without nets to those with treated bed nets. The same general trend was found regarding the proportion of people sleeping on a mattress (table 13).

**Table 13. Proportion of people sleeping in a bed with a mattress, by study group (n=303)**

	Group		
	Without bed nets (A)	Untreated bed nets (B)	Treated bed net (C)
Average percentage of people sleeping in a bed with a mattress	8.00	23.39	40.31
95% Confidence intervals	2.59, 13.41	15.48, 31.30	39.41, 49.20

When comparing two groups at a time, P-values were; group A Vs. B  $P=0.002$ ; group B Vs. C  $P=0.005$ ; group A Vs. C  $P<0.001$

## Sleeping on a mat

Households without bed nets had higher average percentage of people sleeping on a mat (91.46%)

than those with

untreated

(73.05%) and

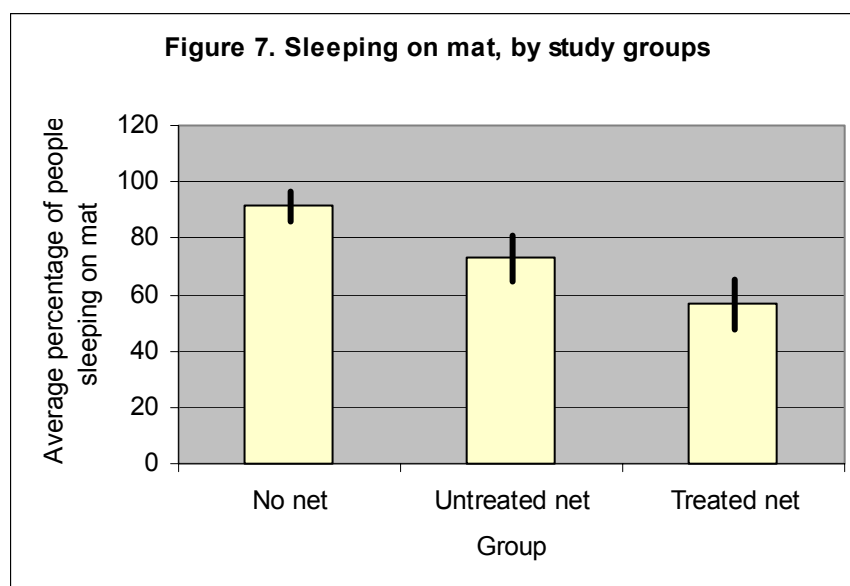
with treated bed

nets (56.56%).

When

comparing two

groups at a



time, it was shown that the differences between each pair were statistically significant.

**Table 14. Proportion of people sleeping on a mat, by study group (n=303)**

	Group		
	Without bed nets (A)	Untreated bed nets (B)	Treated bed net (C)
Average percentage of people sleeping on a mat	91.46	73.05	56.56
95% Confidence intervals	85.99, 96.92	64.89, 81.21	47.64, 65.47

When comparing two groups at a time, P-values were; group A Vs. B  $P < 0.001$ ; Group B Vs. C  $P = 0.007$ ; Group A Vs. C  $P < 0.001$

The observation carried out after the interviews showed that households without bed

nets had a higher average number of mats per household member (0.51) than

households with untreated (0.42) and treated bed nets (0.35). When comparing two

groups at a time, P values were; Between group A and B:  $P = 0.009$ , between B and C:

$P = 0.058$  and between A and C:  $P < 0.001$ .



## Bed net use

### Sleeping under bed net

There was a moderate, but significant, difference between households with untreated bed nets and treated bed nets regarding the average percentage of people sleeping under bed nets in the households. Households with treated bed nets had a higher average percentage of people sleeping under bed nets (92.19) than with untreated bed nets (84.42) ( $P=0.015$ ). Table 15 and figure 8 illustrate this finding.

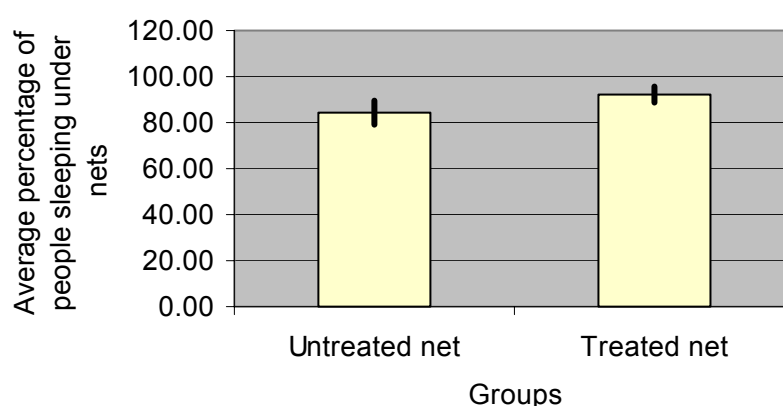
**Table 15. Proportion of household residents sleeping under a bed net, by study group (n=203)**

	Group	
	Untreated bed nets (B)	Treated bed net (C)
Average percentage of people sleeping under a bed net	84.42	92.19
95% Confidence intervals	79.34, 89.49	88.48, 95.90

### Reasons why not all people in a household sleep under a bed net

A question was asked about the reasons why not all people slept under a bed net in the households that owned at least one bed net, but where not all household residents slept under it (n=39). In both groups, a large proportion

**Figure 8. Sleeping under bed nets, by study groups**



mentioned lack of money as the main reason why not all people in the household slept under bed nets (86% and 84%, respectively) ( $P=0.121$ ).

The average number of bed nets per household member as mentioned by heads of households was higher in households with treated bed nets (0.70 nets per person) than in households with untreated bed nets (0.46) ( $P=0.002$ ), as reported by household heads during the interviews. When the interviewers asked to see the nets, a smaller number of nets were recorded. The average number of bed nets in households with treated bed nets was 0.56 per person as compared to 0.46 nets per person in households with untreated nets ( $P<0.001$ ).

### Having slept under bed net last night

Households where the head slept under a bed net last night were more likely to re-treat their bed nets than households in which the heads had not sleep under a bed net at night. Table 16 shows that households with treated bed nets had a higher proportion of heads that had slept under their bed nets the preceding night (81%) than those with untreated bed nets (57%) ( $P<0.001$ ).

**Table 16. Household heads that had slept under a bed net the night preceding the interview, by study group (n=203).**

Did you sleep under bed net last night?	Group	
	Untreated bed net	Treated bed net
Yes	57	83
No	43	20
Total	100	103

Odds ratio	OR	95% C.I.	P-value
Treated nets vs. Untreated nets	3.13	(1.67, 5.87)	$P<0.001$

### Reasons for not having slept under a bed net last night

There was an association between the reasons for not sleeping under bed nets last night and the use and re-treatment of bed nets (n=63). A relatively high proportions of the heads of households with untreated bed nets (65%) and with re-treated bed nets

(60%) said that they did not sleep under their bed nets last night because there was no mosquitoes. Eleven per cent of the households with untreated and 20% treated bed nets said they did not sleep under bed nets last night because they were on transit. Fourteen percent of households with untreated nets, and none of households with treated bed nets, said they did not sleep under the bed net last night because their nets were not hung above the beds ( $P=0.143$ ).

### **Correctly hung bed nets**

With the permission of the household head, the interviewers visited the bedrooms in each visited household in order to assess whether bed nets were correctly hung.

Whether a bed net is correctly placed may influence its effectiveness. Table 17 shows that a higher percentage of households with treated bed nets had correctly hung bed nets (82%) than households with untreated bed nets (59%) ( $P < 0.001$ ).

**Table 17. Correctly hung bed nets in households, by study groups ( $N = 203$ ).**

Was the bed nets correctly hung?	Group	
	Untreated bed net	Treated bed net
Yes	59	84
No	41	19
Total	100	103

### **Reasons for not having a bed net**

When asked to give reasons for not having a bed net, almost all heads of households without bed nets mentioned that bed nets were expensive (94%).

**Table 18. Reasons for not having a net ( $n=100$ )**

Reason	Frequency
Expensive	94
Not available	4
Not a priority	1
No mosquitoes	1
Total	100

The majority of the interviewed heads of households with untreated nets said that they did not treat their bed nets because there were not many mosquitoes (37%), while a somewhat smaller proportion said it was because the insecticides were expensive (32%).

***Table 19. Reasons for not even a single net treated in a household (n=100)***

Reason	Frequency
There is no many mosquitoes	37
Insecticide is expensive	32
Insecticide has side effects	11
Insecticide does not help	8
Insecticide is not available	5
Net is not yet hung above the bed	3
Treating a net is inconvenient	2
Forgotten to treat	2
Total	100

## Bed net characteristics

### **Preference of colour of bed nets**

In the study villages, only green and white coloured bed nets were available.

Approximately the same proportions of heads of households with untreated bed nets (90%) and with treated bed nets (89%), as compared to 76% without bed nets, mentioned green as the most preferred colour of bed nets. Interestingly, a higher proportion of those without bed nets (22%) said they preferred blue colour than 9% with untreated bed nets and 5% of the households that treated their bed nets. The differences found when comparing the group of households with treated bed nets to those without bed nets ( $P=0.005$ ), and the group with untreated nets to those without bed nets ( $P=0.022$ ), were significant. When comparing the group of households with untreated bed nets and the one with re-treated bed nets, the difference was not statistically significant ( $P = 0.190$ ).

Slightly higher proportions of the households with treated bed nets (58%) and with untreated bed nets (57%) than households without nets (50%) mentioned that the reason why they preferred green colour was that it doesn't get dirty easily. In contrast, a slightly higher proportion of the household heads without bed nets (47%) said that they preferred green colour because it was attractive, compared to 41% and 38% with untreated and retreated bed nets, respectively. When comparing two groups at a time, it was found that the differences were not significant. Between households without bed nets and untreated bed nets the P-value was 0.207. It was 0.307 in the comparison between untreated and treated and 0.252 between without and treated bed nets).

### **Preferred size of bed nets**

This study has shown that there was an association between the preferred size of bed nets and bed net use and re-treatment. Higher proportions of the households with treated and untreated bed nets (64 and 62%, respectively) than those without a bed net (40%) said they preferred medium size (4.5x6 ft) bed nets. A significant difference was shown only between the group of households with untreated and no bed nets ( $P=0.007$ ) and between the group of household with treated bed nets and no bed nets ( $P=0.001$ ). The difference was not statistically significant in the comparison between the group of households with untreated and treated bed nets ( $P=0.794$ ).

Almost the same proportions of those with treated and untreated bed nets (59 and 60%, respectively), but a lower percentage of households without bed nets (49%), said the reason why they preferred medium sized nets was that they were equal to the size of their beds. However the differences were not significant. Between households without bed nets and untreated bed nets,  $P$  was 0.457, between untreated and treated it was 0.775, and between without and treated bed nets it was 0.270.

### **Preferred type of bed nets**

Equal proportions of the household heads with treated bed nets and no bed nets (97%), and a slightly smaller proportion of households with untreated bed nets (95%) mentioned rectangular as the most preferred type of bed nets. It was shown that the differences were not significant (the P-value was 0.470 in the comparison between households without bed nets and untreated bed nets, 0.445 between untreated and treated, and 0.971 between without and treated bed nets).

More or less the same proportions of the households with untreated (64%), treated (62%) and no bed nets (60%), mentioned that they preferred rectangular nets because they were easy to hang over the bed. These differences were not significant (the P-value in the comparison between households without bed nets and with untreated bed nets was 0.560, 0.661 between untreated and treated nets, and 0.952 between households with no and treated bed nets).

## **Awareness and knowledge about mosquitoes, malaria and bed nets**

### **Malaria educational sessions**

The majority of the household heads in the study area had attended malaria educational sessions at least once. Almost all of the households with treated bed nets (99%) had heads who, said that they had attended malaria educational session, as compared to 89% of the household heads with untreated and 74% without bed nets ( $P < 0.001$ ).

**Table 20. Whether household heads had ever attended a malaria educational session, by study group (n=303)**

Have you ever attended a malaria educational session?	Group		
	Without bed nets	Untreated bed net	Treated bed net
Yes	74	89	102
No	26	11	1
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	2.84	(1.32, 6.14)	P=0.006
Treated nets vs. Untreated nets	12.61	(1.60, 99.58)	P=0.002
Treated nets vs. no nets	35.84	(4.76, 270.05)	P<0.001

Households with treated bed nets had heads that had attended a higher average number of malaria educational sessions (2.9) than households with untreated nets (2.6 sessions) and households without bed nets (2.2 sessions). The difference was only statistically significant between households with treated bed nets and without bed net at all (P=0.021). In the comparisons between the groups of households with untreated nets and no nets, and untreated vs. treated bed nets, the differences were not significant (P-values of 0.157 and 0.188, respectively).

When asked about whom had provided the last malaria educational session, most heads of households mentioned the Kihansi Public Health Project as the main provider of health education. A slightly higher proportion of household heads with treated bed nets (96%) said they got health education from the Kihansi Public Health Project than the equal proportions of household heads with untreated and no bed nets (94%) (P=0.241).

### **Malaria information from other sources**

Table 21 shows that a high proportion of households with treated bed nets (82.52%) had heads who got malaria information from other sources than face-to-face health

education, compared to only 45% of the households with untreated bed nets and 22% without nets ( $P<0.001$ ).

**Table 21. Household heads that had received malaria information from other sources, by study group (n=303).**

Have you got any malaria information from other sources?	Group		
	Without bed nets	Untreated bed net	Treated bed net
Yes	22	45	85
No	78	55	18
Total	100	100	103

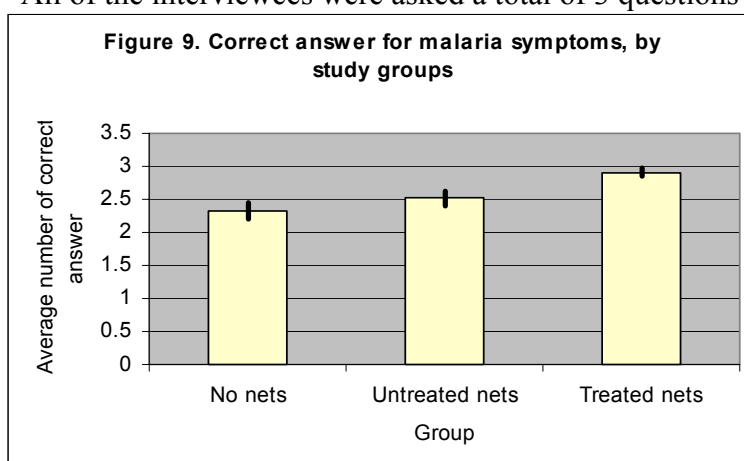
<b>Odds ratios</b>	<b>OR</b>	<b>95% C.I.</b>	<b>P-value</b>
Untreated nets vs. no nets	2.90	(1.57, 5.37)	$P=0.001$
Treated nets vs. Untreated nets	5.77	(3.03, 10.98)	$P<0.001$
Treated nets vs. no nets	16.74	(8.36, 33.53)	$P<0.001$

When asked about other sources of information, a higher proportion of the household

heads with treated bed nets (54%) than with untreated bed nets (47%) and without bed nets (32%) mentioned the radio as the most used other sources of information. 30% of the heads of households with treated bed nets said they got information from leaflets, as compared to a smaller but equal proportion of those with untreated bed nets and without bed nets (18%). The difference was statistically significant only when comparison was made between households with treated nets and no nets ( $P=0.007$ ). Between households with untreated bed nets and without bed net ( $P=0.514$ ) and between households with untreated and treated bed nets ( $P=0.054$ ).

## Knowledge about malaria symptoms

All of the interviewees were asked a total of 3 questions about malaria symptoms and



each correct answer was coded as one point. Households with treated bed nets had heads with a considerably higher average number of correct



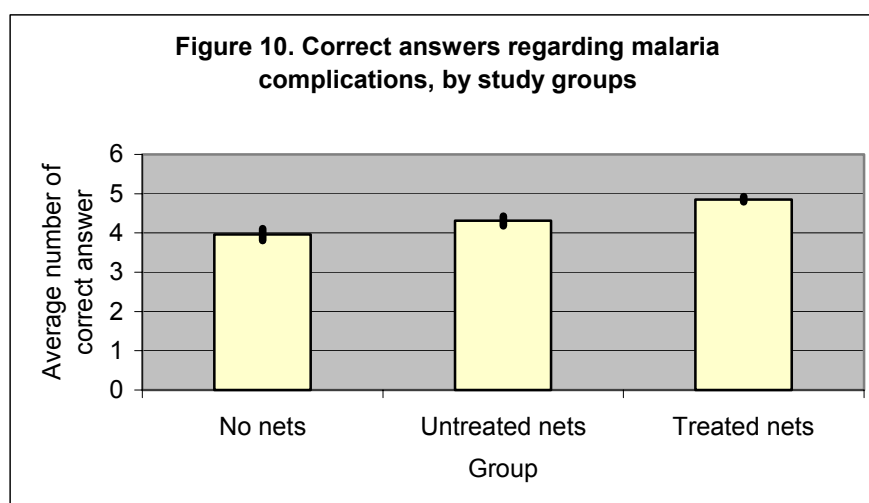
answers on malaria symptoms (2.91) than those households with untreated (2.52) and without bed nets (2.33). As shown just below table 22, when comparing two groups at a time using t-test, the differences in the level of knowledge on malaria symptoms between the groups were statistically significant. In addition to this table, figure 9 illustrates the difference in these groups and their 95% confidence intervals.

**Table 22. Knowledge about malaria symptoms among household heads, by study group (n=303)**

	Group		
	Without bed nets (A)	Untreated bed net (B)	Treated bed net (C)
Average number on correct answers regarding malaria symptoms	2.33 (78%)	2.52 (84%)	2.91 (97%)
95% Confidence interval	2.21, 2.45	2.41, 2.63	2.86, 2.97

When comparing two groups at a time, P-values were; group A Vs. B P=0.022; group B Vs. C P<0.001; group A Vs. C P<0.001

## Knowledge about malaria complications



All of the interviewed household heads were asked a total of 5 questions about malaria

complications and each correct answer was coded as one point. Household heads with treated bed nets had a moderately higher average number of correct answers (4.85) than those with untreated nets (4.31), and a much higher average than those without bed nets (3.96). When comparing two groups at a time, the differences found were statistically significant as shown just below table 23. Figure 10 provides a graphical illustration of the differences among the groups.

**Table 23. Knowledge about malaria complications among household heads, by study group (n=303)**

	Group		
	Without bed nets (A)	Untreated bed net (B)	Treated bed net (C)
Average number of correct answers regarding malaria complications	3.96 (79%)	4.31 (86%)	4.85 (97%)
95% Confidence interval	3.81, 4.11	4.19, 4.43	4.79, 4.92

When comparing two groups at a time, P-values were; group A Vs. B  $P < 0.001$ ; group B Vs. C  $P < 0.001$ ; group A Vs C  $P < 0.001$

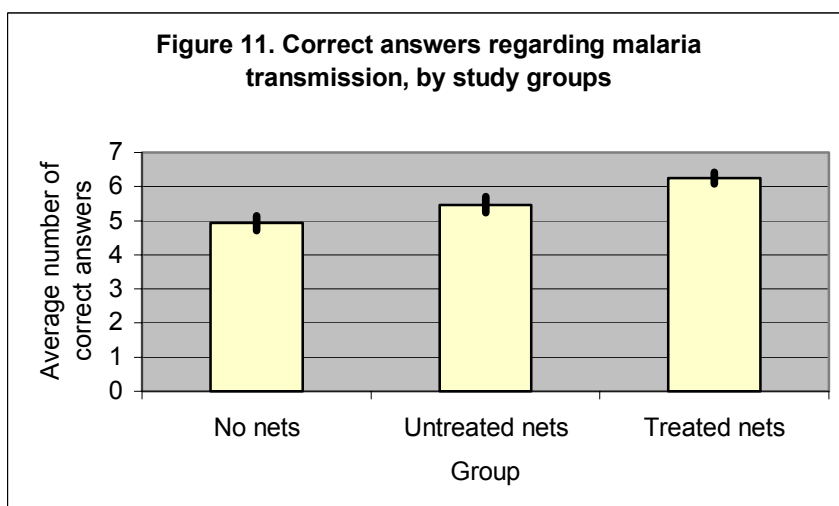
### **Knowledge about malaria transmission**

The interviewed household heads were asked a total of 7 questions about malaria transmission and each correct answer was coded as one point. Table 24 shows that households with treated bed nets had heads with a higher level of knowledge about malaria transmission (an average of 6.24 correct answers) compared to households with untreated bed nets (5.47) and without bed nets (4.93). When comparing two groups at a time, the differences were statistically significant. In addition to table 24, these results are also illustrated in figure 11.

**Table 24. Knowledge about malaria transmission among household heads, by study group (n=303)**

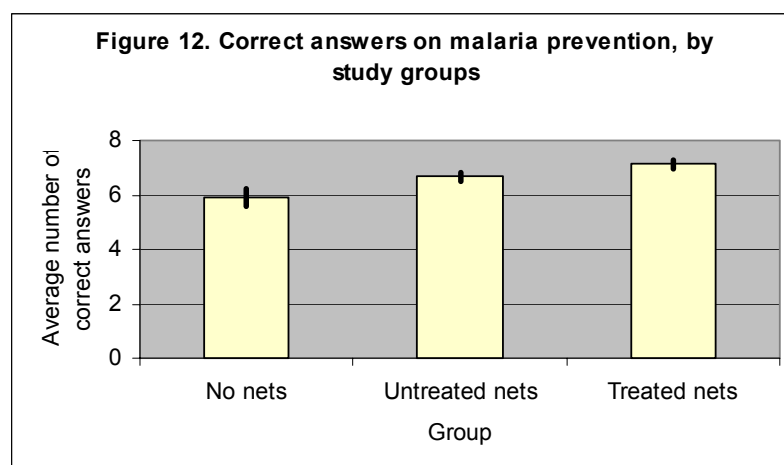
	Group		
	Without bed nets (A)	Untreated bed nets (B)	Treated bed nets (C)
Average correct answers regarding malaria transmission	4.93(70%)	5.47 (80%)	6.24 (89%)
95% Confidence interval	4.71, 5.15	5.24, 5.70	6.08, 6.41

When comparing two groups at a time, P-values were; group A Vs. B  $P = 0.001$ ; group B Vs C  $P < 0.001$ ; group A Vs. C  $P < 0.001$



## Knowledge about malaria prevention

All the 303 interviewed heads of households were asked 8 different questions related to prevention of malaria. Each correct answer was given a score of 1 point



in order to assess different levels of knowledge among the groups. Table 25 shows that heads of households with treated bed nets had a higher level of knowledge about the prevention of malaria (the average number of correct answers was 7.12) compared to households with untreated bed nets (6.66) and without bed nets (5.90).

Comparisons between two groups at a time showed that the differences were highly significant. Figure 12 illustrates this in more detail.

**Table 25. Knowledge about malaria prevention among household heads, by study group (n=303)**

	Group		
	Without bed nets	Untreated bed nets	Treated bed nets
Average number of correct answers regarding malaria prevention	5.90 (74%)	6.66 (83%)	7.12 (89%)
95% Confidence interval	5.58, 6.22	6.47, 6.85	6.92, 7.31

When comparing two groups at a time, P-values were; group A Vs. B P = 0.001; Group B Vs. C P< 0.001; group A Vs. C P<0.001.

## Perception of malaria and the use of other preventive methods

### Seen mosquitoes in the hamlet

The majority of the interviewed heads of households seemed to know that there were mosquitoes in their hamlet. Table 26 shows that all heads of households with both re-treated and untreated bed nets said they sometimes saw mosquitoes in their hamlets, compared to 96% of those without bed nets (P=0.016).

**Table 26. Whether the household heads had seen mosquitoes in their hamlet of residence, by study group (n=303).**

	Group		
	Without bed nets	Untreated bed net	Treated bed net
Do you sometimes see mosquitoes in this hamlet?			
Yes	96	100	103
No	4	0	0
Total	100	100	103

### Getting malaria in the hamlet

Malaria seemed to be perceived as among the health related problems in the study area. Almost all interviewed heads of households with treated and untreated bed nets (99 and 98%, respectively), and 95% without bed nets, said that some people get malaria in their hamlets (P=0.381).

## Other malaria preventive methods

Table 27 shows that households with treated bed nets more often used other malaria preventive methods (26.2%) than those with untreated bed nets (6%) and without bed nets (4 %) ( $P<0.001$ ).

It was found that destruction of breeding sites was the most frequently used way to prevent malaria, as cited by a high proportion of heads with both treated bed nets (92.6%), untreated bed nets (66.7%) and no bed nets (100%) ( $P=0.258$ ).

**Table 27. Use of other malaria preventive methods, by study group (n=303).**

	Group		
Do you use some other malaria preventive methods?	Without bed nets	Untreated bed net	Treated bed net
Yes	4	6	27
No	96	94	76
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	1.53	(0.42, 5.60)	$P=0.516$
Treated nets vs. Untreated nets	5.57	(2.19, 14.18)	$P<0.001$
Treated nets vs. no nets	8.53	(2.86, 25.42)	$P<0.001$

## Awareness and knowledge about insecticides

### Ever heard about insecticides for treating bed nets

The majority of the interviewees had heard about insecticides used for treating bed nets, but there were significant differences between the three groups. Table 28 shows that all heads of households with treated bed nets had heard about insecticides, compared to almost all of those who had untreated bed nets (99%) and 85% of those without bed nets ( $P<0.001$ ).

**Table 28. Whether household heads had ever heard about insecticides, by study group (n=303).**

Have you ever heard about insecticides for treating bed nets?	Group		
	Without bed nets	Untreated bed net	Treated bed net
Yes	85	99	103
No	15	1	0
Total	100	100	103

#### **Odds ratios**

#### **OR**

#### **95% C.I.**

#### **P-value**

Untreated nets vs. no nets

17.42

(2.26, 135.02)

P<0.001

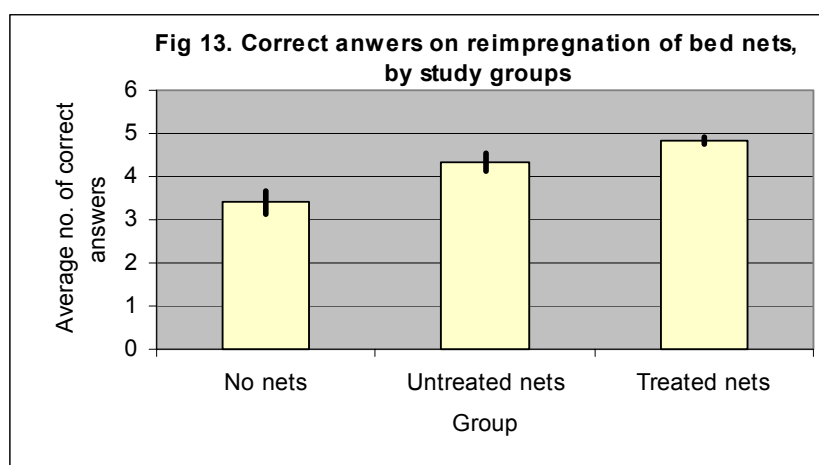
Odds ratio was not calculated between the group of households with treated bed nets and no nets, and between treated and untreated bed nets, because all household heads with treated bed nets had heard about insecticides for treating bed nets.

### **Source of information about insecticides**

A higher proportion of households with untreated bed nets (88%) had heads that said they had heard about insecticides from the Kihansi Public Health Project than those without bed nets (85%) and with treated bed nets (80%). When comparing two groups at a time, the difference found between the households with untreated bed nets and without bed nets was statistically significant (P=0.014). The difference between treated bed nets and without bed nets was also significant (P=0.038), while the difference between untreated and treated bed nets was not (P=0.422).

### **Knowledge about the re-impregnation of bed nets**

The interviewed heads of the households were asked a total of 5 questions, and each



correct answer was graded as one point. Table 29 show that the heads of households with treated bed nets had

a high level of knowledge (on the average 4.84 correct answers out of 5) compared to households with untreated bed nets (4.32) and without bed nets (3.41). When the groups were compared two at a time, it was found that the differences were statistically significant as shown by the P-values in the table. The differences are illustrated once again in Figure 13.

**Table 29. Knowledge about re-impregnation of bed nets among household heads, by study group (n=303).**

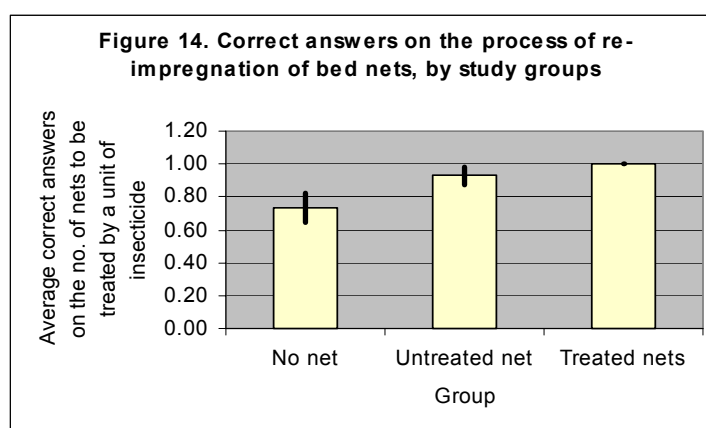
	Group		
	Without bed nets	Untreated bed nets	Treated bed nets
Average number of correct answers regarding re-impregnation of nets	3.41 (68%)	4.32 (86%)	4.84 (97%)
95% Confidence interval	3.14, 3.68	4.14, 4.50	4.76, 4.93

When comparing two groups at a time, P-values were; group A Vs. B P = 0.001; group B Vs C P<0.001; group A Vs. C P<0.001

### Knowledge on how to treat bed nets with insecticides

All interviewed heads of households were asked how many bed nets that can be

treated with one sachet or tablet of insecticide. Correct answers were given a score of one point, whereas incorrect answers were rated as zero. Table 30 shows that



heads of households with treated bed nets were more knowledgeable (average score of 1.00) than households with untreated bed nets (0.93) and without bed nets (0.73).

When the groups were compared two at a time, it was found that the differences were statistically significant, as shown by the P-values in table 31. The 95% CI for the group of treated bed nets could not be made because all of the respondents had the

same correct answers on the process of re-impregnation of bed nets. Figure 14 illustrates the differences further.

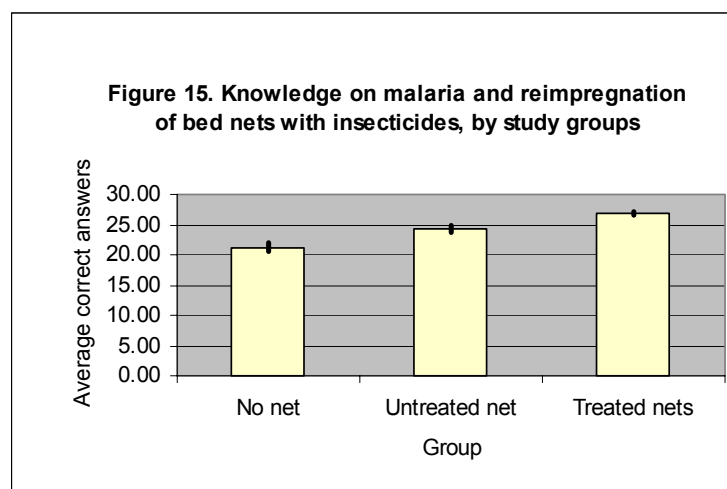
**Table 30. Knowledge about re-impregnation of bed nets among household heads, by study group (n=303).**

	Group		
	Without bed nets	Untreated bed nets	Treated bed nets
Average of correct answers regarding the number of bed nets that can be treated by one sachet/tablet of insecticide	0.73	0.93	1.00
95% Confidence interval	0.64, 0.82	0.88, 0.98	none

When comparing two groups at a time, P-values were; group A Vs. B  $P < 0.001$ ; group B Vs C  $P = 0.008$ ; group A Vs. C  $P < 0.001$

### Knowledge on malaria and bed net re-impregnation

Table 31 and figure 15 presents the overall knowledge-score for each of the three study groups. All the interviewees were asked a total of 29 knowledge-related questions as part of this survey. The results have been presented according to



topic earlier in the present report, but here they are combined into one overall score for each study group. The table shows that the heads of households with treated bed nets had a considerably higher overall level of knowledge about mosquitoes, malaria, bed nets and insecticides (average score of 26.97) than households with untreated bed nets (24.21) and without bed nets (21.26). When the groups were compared two at a



time, it was found that the differences were statistically significant as indicated by the P-values reported in table 31.

**Table 31. Total number of correct answers to 29 knowledge-related questions, by study group (n=303).**

	Group		
	Without bed nets	Untreated bed nets	Treated bed nets
Average number of correct answers regarding malaria and re-impregnation of bed nets	21.26 (73%)	24.21 (83%)	26.97 (93%)
95% Confidence interval	20.49, 22.03	23.69, 24.73	26.66, 27.28

When comparing two groups at a time, P-values were; group A Vs. B  $P < 0.001$ ; group B Vs C  $P < 0.001$ ; group A Vs. C  $P < 0.001$

### Thoughts on the effectiveness of insecticides

The vast majority of the interviewed people in the study area seemed to believe in the effectiveness of insecticides for treating bed nets. Table 32 shows that all interviewed heads of households with treated and untreated bed nets, and 96% of the households without bed nets, thought that insecticide is helpful in the prevention of malaria ( $P=0.016$ ). Interestingly, no one thought that insecticides cannot prevent malaria, but 4% of those without bed nets could either not provide any information or didn't know whether it helps or not.

**Table 32. Perceived effectiveness of insecticide-treated bed nets (ITNs), by study group (n=303).**

	Group		
	Without bed nets	Untreated bed net	Treated bed net
Do you think ITNs help to prevent malaria?			
Yes	96	100	103
Unknown/No response	4	0	0
Total	100	100	103

Table 33 shows that 100% of the heads of households with treated bed nets felt that insecticides help 'very much' in the prevention of malaria. The corresponding percentages were high, although slightly lower, also among household heads with untreated nets (95%) and without bed nets (83%). 13% of the households without bed

nets and 4% with untreated bed nets had heads that said that insecticides help to a 'certain extent'. Interestingly, among those who said insecticides help to prevent malaria, no one said that it helps 'a little bit', but one out of a hundred household heads with untreated bed nets said he didn't know whether it can help or not ( $P<0.001$ ).

**Table 33. Extent to which people believe in insecticides, by study group (n=299)**

To what extent do you think insecticide can help to prevent malaria?	Group		
	Without bed nets	Untreated bed net	Treated bed net
Very much	83	95	103
To a certain extent	13	4	0
A little bit	0	0	0
Unknown/No response	0	1	0
Total	96	100	103

### Thoughts on side effects of insecticides

Most of the interviewed heads of households believed that insecticides for treating bed nets were safe. Table 34 shows that almost all of the households with treated bed nets (99%) had heads who thought that insecticides have no side effects, as compared to 85% of households with untreated bed nets and 76% without bed nets. However, a higher proportion of the households without bed nets (18%) had heads that either didn't know or could not provide any answer, as compared to 2% with untreated bed nets and none with treated bed nets. When comparing two groups at a time, it was shown that the differences among the groups were statistically significance ( $P<0.001$ ).

**Table 34. Thoughts on side effects of insecticide, by study group**

Do you think insecticides for treating bed nets is safe	Group		
	Without nets	Untreated bed nets	Treated bed nets
Yes	76	85	102
No	24	15	1
Total	100	100	103

	<b>OR</b>	<b>95% C.I.</b>	<b>P-value</b>
Untreated vs. no. nets	1.79	0.88, 3.66	P=0.108
Treated vs. untreated	18.00	2.33, 139.07	P<0.001
Treated vs. no.net	32.21	4.26, 243.37	P<0.001

Those who thought that insecticides might have side effects were asked what type of side effects they suspected. The common cold was the most commonly mentioned side effect. It was mentioned by a person who was asked in the group of households having treated bed nets (100%), 69% of the respondents with untreated nets and 50% of subjects without bed nets. Other mentioned side effects were body itching and headache. The differences were not significant (P-value when comparing households with untreated bed nets and no bed nets was 0.698, 0.806 when comparing households with treated and untreated bed nets, and 0.646 when comparing households with treated and without bed nets).

## Distribution channels and availability of bed nets and insecticides

### Source of bed nets

A high proportion of household heads with treated and untreated bed nets (97 and 96%, respectively) said they bought their nets through the Kihansi Public Health Project. Only 2% of those with treated bed nets, and 1% with untreated nets, mentioned that they bought their nets from a shop or kiosk in the village. 1% and 3% of households with treated and untreated nets, respectively, explained that they bought their nets outside of their villages (P=0.504).

## Availability of insecticides

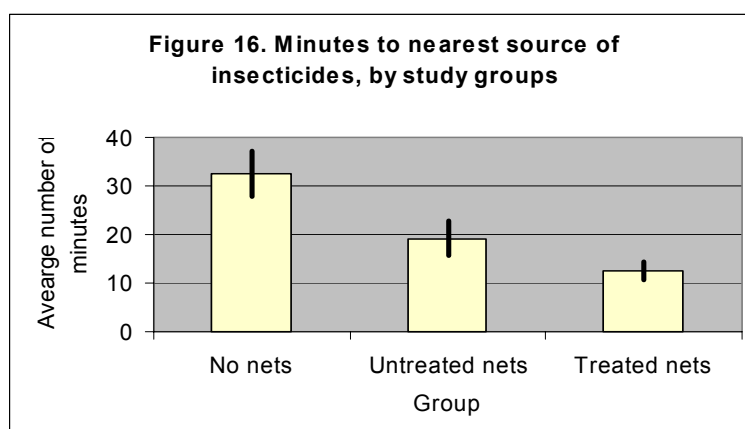
Table 35 shows that almost all (99%) households with treated bed nets had heads that said that insecticides were available in their village, as compared to 78% of households with untreated nets and 63% of households without bed nets. A higher proportion of the households without bed nets (22%), said they either did not know or could not provide any information about the availability of insecticides in their villages than households with untreated bed nets (13%) and treated bed nets (0%) ( $P<0.001$ ).

**Table 35. Availability of insecticides, by study group (n=303).**

Is insecticide available in this village?	Group		
	Without bed nets	Untreated bed net	Treated bed net
Yes	63	78	102
No	15	9	1
Unknown/No response	22	13	0
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	2.06	(0.85, 5.03)	P=0.106
Treated nets vs. Untreated nets	11.77	(1.46, 94.86)	P=0.004
Treated nets vs. no nets	24.29	(3.13, 188.36)	P<0.001

Table 36 shows that households without bed nets lived further away from their nearest source of insecticides (the average travel time was 32.41 minutes), than



households with untreated bed nets (19.19 minutes) and treated bed nets (12.43 minutes). When comparing two groups at a time, these distances were found to be

statistically significant as shown by the P-values presented just below table 36. Figure 16 illustrates these differences graphically.

**Table 36. Distance to the nearest source of insecticides, by study group (n=243).**

	Group		
	Without bed nets (A)	Untreated bed nets (B)	Treated bed nets (C)
Average travel time	32.41	19.19	12.43
95% Confidence interval	27.77, 37.06	15.66, 22.72	10.54, 14.32

When comparing two groups at a time, P-values were; group A Vs. B  $P<0.001$ ; group B Vs. C  $P=0.003$ ; group A Vs C  $P<0.001$

### **Affordability of insecticides for re-treating bed nets**

Table 37 shows that a higher proportion of the households without bed nets (67%) had heads who said that insecticides were expensive than those with untreated bed nets (49%) and treated bed nets (18%) ( $P<0.001$ ).

**Table 37a. Perception of insecticides as expensive, by study group (n=303)**

	Group		
	Without bed nets	Untreated bed net	Treated bed net
Is insecticide for treating bed nets expensive?			
Yes	67	49	19
No	33	51	84
Total	100	100	103

<b>Odds ratios</b>	<b>OR</b>	<b>95% C.I.</b>	<b>P-value</b>
Untreated nets vs. no nets	0.47	(0.27, 0.84)	$P=0.010$
Treated nets vs. Untreated nets	0.24	(0.30, 0.44)	$P<0.001$
Treated nets vs. no nets	0.11	(0.06, 0.21)	$P<0.001$

Let us consider those who feel that insecticide is CHEAP

**Table 37b. Perception of insecticide as cheap, by study group**

	Group		
	Without nets	Untreated bed nets	Treated bed nets
Is insecticide for treating bed nets cheap?			
Yes	33	51	84
No	67	49	19
Total	100	100	103

	<b>OR</b>	<b>95% C:I</b>	<b>P-value</b>
Untreated vs. no. nets	2.11	1.19, 3.75	P=0.010
Treated vs. untreated	4.25	2.25, 8.01	P<0.001
Treated vs. no.net	8.98	4.69, 17.18	P<0.001

Table 38 shows that a high proportion of the household heads with treated bed nets said insecticides should fairly be sold at a price of Tshs. 200 (80%) compared to untreated bed nets (58%) and without bed nets (57%). A relatively high proportion of the household heads without bed nets (24%) said it should be sold for Tshs 100 compared to with untreated bed nets (23%) and with treated bed nets (15%). The average price mentioned by heads of household with treated bed nets was Tsh 190 while corresponding average for households with untreated bed nets was Tsh. 175, and for households without bed nets was Ths.190.

**Table 38. Thoughts on how much insecticides should fairly be sold, by study group (n=135)**

<b>Price Tshs.</b>	<b>No nets</b>	<b>Untreated bed nets</b>	<b>Treated bed nets</b>
.00	0	1 (2.1%)	0
50.00	0	1 (2.1%)	0
100.00	16 (23.9%)	11 (22.9%)	3 (15.0%)
150.00	2 (3.0%)	2 (4.2%)	0
200.00	38 (56.7%)	28 (58.3%)	16 (80.0%)
250.00	2 (3.0%)	3 (6.3%)	0
300.00	9 (13.4%)	2 (4.2%)	1 (5.0%)
Total	67 (100.0%)	48 (100.0%)	20 (100.0%)

## The process of net re-treatment

### Availability of container for re-treating bed nets

Table 39 shows that all of the households with treated bed nets had a container that could be used for re-treatment of bed nets, compared to 85% of the households with untreated bed nets and 52% of those without bed nets (P< 0.001).

The observation exercise conducted after the interview showed that a higher proportion of the households with treated bed nets (95%) had containers that could be used for re-treatment of bed nets than households with untreated bed nets (87%) and without bed nets (50%) ( $P < 0.001$ ). These results are consistent with the ones from the responses of the interviewed heads of households (table 39) with the same trend and interpretation.

**Table 39. Availability of a container that could be used for re-treatment of bed nets, by study group (n=303)**

Do you have container that could be used for re-impregnation of bed nets	Group		
	Without bed nets	Untreated bed net	Treated bed net
Yes	52	85	103
No	48	15	0
Total	100	100	103

**Odds ratios**

**OR**

**95% C.I.**

**P-value**

Untreated nets vs. no nets

5.23

(2.66, 10.27)

$P < 0.001$

Odds ratio was not calculated between the group of households with treated bed nets and no net, and between treated and untreated nets, because all household with treated bed nets had containers that could be used for re-treatment of bed nets with insecticides.

**Thoughts on the time used for re-treatment of bed nets**

Table 40 shows that a higher proportion of households without bed nets (4%) had heads who said that they thought that treating a bed nets takes much time than heads of households with untreated (1%) and treated bed nets (0%) ( $P < 0.001$ ).

Odds ratio was not calculated between the group of households with treated bed nets and untreated nets, and between treated and no nets, because no one in the group of households with treated bed nets thought that re-treating a bed net takes much time.

**Table 40. Thoughts on the time used for treatment of bed nets, by study group (n=303)**

	Group		
Do you think treating a bed net takes much time?	Without bed nets	Untreated bed net	Treated bed net
Yes	4	1	0
No	58	90	103
Unknown/No response	38	9	0
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	0.16	(0.02, 1.48)	P=0.068

### Thoughts on the difficulties for treatment of bed nets

A higher proportion of the households without bed nets (7%) had heads who said that treating a bed net with insecticide is difficult than heads of the households with untreated (2%) and treated nets (0%) ( $P < 0.001$ ).

**Table 41. Thoughts on whether treatment of bed nets is difficult, by study group (n=303)**

	Group		
Do you think treating a bed net with insecticide is difficult?	Without bed nets	Untreated bed net	Treated bed net
Yes	7	2	0
No	57	90	103
Unknown/No response	36	8	0
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	0.18	(0.04, 0.90)	P=0.021

Odds ratio was not calculated between the group of households with treated bed nets and untreated nets, and between treated and no nets, because no one in the group of households with treated bed nets thought that treating a bed net is difficult.

### Forgetting to re-treat bed nets

A higher proportion (17%) of households with untreated bed nets had heads who said that they sometimes forget to treat their bed nets, as compared to 2.9% of the heads of households with treated bed nets ( $P < 0.001$ ).



**Table 42. Forgetting to treat bed nets with insecticide, by study group (n=203).**

	Group	
	Untreated bed net	Treated bed nets
Do you sometimes forgetting to treat your bed nets with insecticides?		
Yes	17	3
No	73	100
Unknown/No response	10	0
Total	100	103

Odds ratios	OR	95% C.I.	P-value
Treated nets vs. Untreated nets	0.13	(0.04, 0.46)	P=0.001

## Malaria-related symptoms and parasitaemia

### Malaria-related symptoms among heads of households

Household heads using treated bed nets were less likely to report malaria-related symptoms than those with untreated nets, and much less likely to report malaria symptoms than those without bed nets. Table 43 shows that a higher proportion of heads of households without bed nets (40%) had a history of malaria-related symptoms during the past 4 weeks than those with untreated (29%) and treated bed nets (1.94%) (P<0.001).

**Table 43. Malaria-related symptoms among household heads, by study group (n=303).**

	Group		
	Without bed nets	Untreated bed net	Treated bed net
Have you had malaria related symptoms in the past 4 weeks?			
Yes	40	29	2
No	60	71	101
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	0.61	(0.34, 1.10)	P=0.102
Treated nets vs. Untreated nets	0.48	(0.01, 0.21)	P<0.001
Treated nets vs. no nets	0.03	(0.01, 0.13)	P<0.001

## Malaria-related symptoms among other household members

Households that did not have bed nets were more likely to have had household members with malaria-related symptoms than those with untreated and treated bed nets. Table 44 shows that a high proportion of the households heads without bed nets (41%) reported that their households had had other household members with malaria-related symptoms during the past 4 weeks, compared to 34% with untreated bed nets and 7% with treated bed nets ( $P<0.001$ ).

**Table 44. Malaria-related symptoms among other household members, by study group (n=303).**

	Group		
Have any other household member had malaria related symptoms in past 4 weeks?	Without bed nets	Untreated bed net	Treated bed net
Yes	41	34	7
No	59	66	96
Total	100	100	103

Odds ratios	OR	95% C.I.	P-value
Untreated nets vs. no nets	0.74	(0.42, 1.32)	P=0.300
Treated nets vs. Untreated nets	0.14	(0.06, 0.34)	P<0.001
Treated nets vs. no nets	0.11	(0.04, 0.25)	P<0.001

## Parasitaemia

This table shows that a higher proportion of the households without bed nets (12.63%), had heads with positive malaria slide results than households with untreated bed nets (8.42%) and with treated bed nets (3.92%) ( $P=0.025$ ).

**Table 45. Presence of malaria parasites, by study group (N = 292).**

	Group		
Results of blood slide	Without bed nets	Untreated bed net	Treated bed net
Positive	12	8	4
Negative	83	87	98
Total	95	95	102

<b>Odds ratios</b>	<b>OR</b>	<b>95% C.I.</b>	<b>P-value</b>
Untreated nets vs. no nets	0.64	(0.25, 1.63)	P=0.344
Treated nets vs. Untreated nets	0.44	(0.13, 1.53)	P=0.187
Treated nets vs. no nets	0.28	(0.09, 0.91)	P=0.025

# MAIN FINDINGS – QUALITATIVE SURVEY

## **General impression**

My general impression is that the informants I spoke to had good knowledge about malaria and its consequences. They offered most of the information spontaneously. Only in some instances probing questions were posed to elicit more information about a specific theme.

The following is a summary of the main findings:

## **Perception of health and diseases**

The informants thought that the major health-related problems in their villages were diseases and their outcomes. Almost all the informants told me that malaria, diarrhoea and cough were the most common diseases. They explained that the consequences of these diseases are continuously having sick people in the villages, inability to do the normal activities for a number of days, and loss of lives for some people.

A few informants told me that shortage of food, the lack of a dispensary in Ihimbo village, and the lack of transport are among the important health related problems in their villages, in addition to diseases.

## **People's perception of malaria**

Most of the people I interviewed told me that malaria causes anaemia, miscarriages, dehydration, high fever with “*degedege*” (convulsions, mostly among children), body weakness and some deaths. A 50 years' old man told me that some people in his village get mental confusion and become mad due to the disease. Most of the

informants said that malaria-related problems lead to an inability to pursue normal daily activities for more than a week, and that this could be a factor leading to poverty. Indeed, people do perceive malaria as a major health threat in these villages, and they think that the seriousness and complications of the disease is a cause of the low economical status of their villages.

### **People's beliefs about the causes of malaria**

Many informants told me that people get malaria because many people do not use treated bed nets, and because some people don't destroy breeding sites for mosquitoes regularly. When asked why they don't do this, they said that many do not have enough money for buying nets and insecticides, and that they don't see mosquitoes during the dry season. People believe that you can get malaria only during the rainy season when they see mosquitoes moving around, and therefore they use bed nets in that period more than during the dry season. A few told me that people get malaria because of frequent visits to the lowland villages where they sell their agricultural products and look for employment opportunities. They have almost no sources of income in their own villages.

### **A story about a visit to the lowland areas**

This is a story illustrating people's beliefs on getting malaria after visiting lowland areas. A lady of 27 years' old told me that she got malaria two weeks earlier after visiting Chita (a lowland village) for three days. The aim of her visit was to sell her agricultural products and "vilango" (locally made mats) and to buy rice, fish and other household needs. The lady told me that after some days she experienced "homa kali" (high fever), chills, headache, joint pains, nausea and vomiting. She got treated in one of the neighbouring village dispensaries and started to get relief after three days. The

lady told me that she wouldn't have had all these terrible symptoms if she had not visited the lowland area two weeks earlier. She was very happy to discuss about malaria.

Two middle-aged women in different villages told me that people get malaria because mosquitoes come from the Kihansi dam. Two other informants said that people get malaria because they do not use other protective devices, like window screening, mosquito coils and sprays, and the reason for this is that they are expensive and that they are not used to them. I got the impression that the majority of the people believe that malaria is caused by mosquito bites, and that they think that the use of treated bed nets, and a lack of destruction of mosquito breeding sites, contributes to this. A minority believes that visiting lowland villages, having a dam in the vicinity, and not using other malaria preventive devices contribute to the transmission of malaria.

### **How malaria is prevented**

Some informants told me that usually people dig drainage channels and bury broken pieces of pots and tins to prevent malaria. Most of the informants indicated that people use bed nets mostly during the rainy season, when there are a lot of mosquitoes. However, many informants said that relatively few people use treated bed nets in these villages due to the cost of the insecticide, fear of side effects and because the insecticide is a new thing in the area. Some informants said that normally people seek treatment from village health workers or dispensary staff soon after feeling the symptoms of malaria because they believe that if you get treated early the chance of transmitting this disease to another person is small. A 42-years old man told me that when a patient presents with severe symptoms like “*homa kali*” (high fever) and “*degedege*” (convulsions), normally people would send him first to a “*mganga wa*

*kienyeji*” (traditional healer) because they associate these symptoms with spirits, and that if injected with a needle the condition becomes worse. It seems clear that many people know how malaria can be transmitted and prevented, but some people do not seek medical treatment early due to social and local beliefs.

### **Effectiveness and efficacy of insecticide treated bed nets**

Almost half of the informants told me that the consequence of re-treatment of bed nets with insecticide is good health of the people because the chemical repels mosquitoes. A 50 years’ old man told me that people who treat their bed nets do not get mosquito bites because “*dawa ya mbu ina harufu inayo fukuza mbu*” (the insecticide has a smell which repels mosquitoes). Half of the informants said just this. A few informants said that people who re-treat their bed nets with insecticides sleep comfortably because the mosquitoes die and the chemical kills other insects like bed bugs and cockroaches. This gives an impression that in addition to prevention of malaria, people think of other benefits of treated bed nets. One respondent said that “*kama nikitumia chandarua changu chenye dawa ipasavyo, sitapata malaria milele*” (if I use my treated net correctly, I will never get malaria). In fact, many people perceive the use of insecticide treated bed nets as an effective way of reducing mosquito density and prevention of malaria, and some people seem to have overconfidence in the efficacy of insecticides.

### **Peoples perceptions of side effects of insecticides**

Almost half of the informants told me that some people believe that insecticides have side effects. The side effects they mentioned most frequently were runny nose, itching of the skin, cough and headaches. A 26-years’ old woman said that a few people think

that insecticides can cause cancer. Three informants said that the side effects are more marked in children, especially runny nose, because children are weaker than adults. A 27 years' old woman told me that some people believe insecticides are toxic to human beings, as they were told that they should put on gloves and bury them after treating the bed nets. In general, people seemed to be knowledgeable about the bed net re-treatment process, but some had beliefs that insecticides can cause harmful effects to human beings. A few people had a highly negative perception of the treated nets, like believing that insecticides cause cancer.

### **Reasons for not re-treating bed nets with insecticides**

Many informants said that people do not treat their bed nets because they don't have enough money, and half of the informants said that people do not re-treat their bed nets because they fear side effects of insecticides. Some said that people don't re-treat their bed nets because they don't understand very well how insecticides can prevent malaria and therefore they do not accept it fully, as it is a new thing in this area. A few informants told me that people don't re-treat their bed nets because they don't see mosquitoes in their hamlets especially during the dry season. Only one respondent told me that people don't treat their bed nets because sometimes insecticides are not available in his village.

## **Summary**

### **Challenges regarding the prevention of malaria**

Almost all the informants told me that people don't have enough money for buying bed nets and re-treating them after every three months, that's why the disease never gets finished in these villages. A 41 years' old man told me that people want to buy



nets and treat them, but they don't manage to buy insecticide every three months. Almost half of the informants told me that malaria never get finished in their villages because people do not use bed nets and destroy breeding sites of mosquitoes throughout the year as they don't see mosquitoes, especially during the dry season. Some people told me that malaria never get eradicated in their villages because people don't treat their bed nets due to fear of side effects of the insecticides.

A small proportion of informants said the malaria problem never gets solved because people make frequent visits to the malaria areas in the lowland and because people don't understand well about malaria transmission, as this is a new disease in the area. A 30-years' old woman told me that people feel that malaria is a disease of the lowland villages, so they are wondering to see it in their own area. This makes some people to feel less responsible to control it, she said. Two informants told me that sometimes bed nets and insecticides are not available in their villages. The impression is that the main challenges to malaria prevention is a combination of issues like cost, side effects, seasonal variations, visits to malaria areas, low understanding on how insecticide can prevent malaria, unreliable availability of insecticides, beliefs on the domination of malaria disease in some areas.

### **Malaria control**

Many informants told me that we could solve the malaria problem quickly in their area by using treated bed nets and destroy the breeding sites of mosquitoes. A slightly smaller proportion told me that using bed nets (without mentioning "treated") could reduce the disease. Almost all informants told me that we could end the problem by making sure people get more health education about the transmission and prevention of malaria.

In addition to these, a few informants said that we should solve the problem by seeking treatment early, testing all people, treating those with malaria parasites and maintaining the availability of nets and insecticides and encourage people to use them.

A 27-years' old woman was open to tell me that we should increase efforts of preventing this disease in our own and ask support from the district and health related projects to give health education and get bed nets and insecticides at a cheap price.

Two informants said people could solve the problem by putting window screenings in their houses, using mosquito sprays and coils. A 42-years' old man told me that they could solve this problem by smoking our houses by burning certain local herbs that repel mosquitoes.

The general impression was that people have good thoughts on how to solve the malaria problem in their respective villages, but the implementation of their ideas seems to be a problem.

## DISCUSSION

This study was conducted in a highland area where there was no local transmission of malaria before. Most likely, the malaria vector was recently introduced in the study villages, probably as a consequence of the environmental changes brought about by construction activities at the Lower Kihansi Hydropower plant. The study villages are located more than 1,000 meters above sea level. There was no road between these villages and the nearby lowland area on the Kilombero plain (a hyper-endemic malaria zone) before the construction of the Lower Kihansi Hydropower plant started, but an access road was constructed as part of this large energy sector development project. Human health conditions in the communities surrounding the Kihansi plant were studied before the commencement of the construction activities. Based on the recommendations given in the baseline studies, the Kihansi Public Health Project (MUAJAKI) was established. The main objective of MUAJAKI is to mitigate health impacts caused by the construction of the plant. MUAJAKI's main activities in the field of malaria control have been training of health personnel and communities' own resource persons, health education including infotainment, social marketing of bed nets and insecticides, and support to case management of malaria in local clinics. The project has supported the distribution of nets in highland villages at a highly subsidised price, aiming at providing as many people as possible with nets at an affordable cost. The main focus, however, has been on the social marketing of insecticides for regular re-impregnation of nets. Bed nets were sold at a subsidised price of Tshs 500 (0.625 dollars) while the market price was Tsh. 4000 (5 dollars). Insecticides were sold at a full market price of Tshs. 400 (0.5 dollars).

## **Age**

The present study has shown interesting findings of using and re-treating bed nets in relation to the age of heads of households. Younger persons in the surveyed communities, where malaria was a relatively new challenge, seemed to have adapted more easily to the use of bed nets than older persons. Households with treated bed nets had younger household heads (mean age 32.7 years) than households with untreated bed nets (36.7 years) and without bed nets at all (42.1 years). Young people are generally more likely to try out new things and challenges in life than older persons. People in this area were not used to malaria because the villages had no local malaria transmission before. In the new epidemiological situation older people seemed to resist changes to a larger extent than younger persons do. They had been in the area for many years and lived their lives without this kind of problem. It needs time for them to adapt. During in-depth interviews with the informants of the qualitative part of this study, several interviewees emphasised that malaria was a new disease in the area, and that there were some resistances to change due to certain traditions and beliefs. Although it was not specified which group that said this, experience shows that old people are more focused on local beliefs and traditions than the young ones.

## **Socio-economic status**

Households with treated bed nets had a higher average income per person per year (Tshs. 69,499) compared to households with untreated (29,773) and without bed nets (23,372). Other indicators of household economy showed the same trend. More households with treated bed nets had roofs of corrugated iron sheets and owned a radio compared to households with untreated and without bed nets. They also had a

higher number of chickens, which contribute to the income of a household because many people buy them, as there are no other sources of meat in these villages. As bed nets and insecticides were distributed through a social marketing approach which involve costs, the ability to pay and the level of income influenced whether one used a bed net and re-treated it or not. Social marketing approaches have good sides as they promote the distribution and use of health related products in a sustainable way. On the other hand, different socio-economic strata of the population are reached to different degrees. There might be some people who want or need a certain product, but cannot afford to buy it. Wealthier people therefore benefit more than those who are poor. The informants of the qualitative part of this study explained that there were very few permanent sources of income in the area and that there were few cash crops that would have contributed to their income. In fact, people in the study area had a very limited purchasing power, and this was true even for those with treated bed nets. However, they were much better off economically than others in the local setting. Before subsidisation, bed nets were generally regarded as expensive. In fact, among those who still do not own a net, the cost was almost one fourth of their annual income. This study has shown that people believed in ITNs and were willing to use and re-treat their nets, but felt that they would not manage to do so due to their low purchasing power. A higher proportion of the households without bed nets (67%) had heads who said that insecticides were expensive than those with untreated bed nets (49%) and treated bed nets (18%). These differences were statistically significant. Almost all informants in the qualitative inquiry acknowledged this problem. They said that people don't have enough money for buying bed nets and re-treating them after every three months, and that's why this disease never gets finished in these villages. A 41 years' old man said that "people want to buy nets and treat them, but they can't

manage to buy insecticide every three months”. It seems clear that low income will inevitably be an obstacle for ITNs programs in countries like Tanzania and it is important that governments and donors realise this before social marketing programs are launched. The level of subsidisation must be high enough so that even low-income households can afford to buy nets and insecticides.

Occupation and employment is connected to household economy as well as to the use and re-treatment of bed nets. A relatively high proportion of the households with treated bed nets had heads that were employed or involved in business compared to households with untreated and without bed nets. Conversely, households with treated bed nets had a lower proportion of heads that were peasants than households with untreated and without bed nets. The experience gained from the study area is that payment of bed nets and insecticide is a very real problem.

Although this study has shown that households with low proportion of using ITNs had low income and that people want to use them, but they feel that don't have enough money, there is a need of conducting further studies on the willingness and ability to pay for ITNs products.

### **Sleeping habits**

Another indicator of household economy is whether a household can afford beds and mattress, or whether the inhabitants sleep on mats on the floor. Households with treated bed nets had a higher average percentage of people sleeping in beds (99%) than households with untreated (89%) and without bed nets (88%). The majority of people in the study area were not having beds with mattresses. However, households with treated bed nets had a much higher average percentage of people sleeping in beds

with mattresses (40%) than households with untreated bed nets (23%) and without bed nets (8%). As it is expensive to buy a simple bed, or a bed with a mattress, households with poor economy choose to sleep on mats. Households with treated bed nets had the lowest average percentage of people sleeping on mat (57%) compared to households with untreated bed nets (73%) and without (91%). In households with low economy, people seem to give first priority to having a bed and followed by a bed net and later the re-treatment of it. It also seems likely that people perceived a net as easier to use as when having a mattress.

### **Knowledge on malaria and re-impregnation of bed nets**

The studied population was rather knowledgeable on malaria and re-impregnation of bed nets, although there were differences between the study groups. Households with treated bed nets had an overall higher level of knowledge (93% correct answers on 29 questions asked as part of this survey) than households with untreated bed nets (83%) and without bed nets (73%). Knowledge by itself is a very important aspect of malaria prevention, because without it, no one will know what to do as far as prevention of malaria is concerned. Knowledge is more important in an area where malaria has been recently introduced because people in such an area have no experience on how to prevent the disease. The use of a bed net is relatively easy, but the re-impregnation of treated bed nets with insecticides is a somewhat complicated process. It is not easy to do unless you know the steps of the re-impregnation process. Willingness and ability to use an ITN also requires awareness and correct knowledge about the effectiveness, efficacy and side effects of nets and insecticides. Households with treated bed nets had higher level of knowledge about these issues than households with untreated and without bed nets. The differences were statistically significant. The interviewees in

the qualitative part of this study also addressed this issue. Some informants said “people don’t re-treat their bed nets because they don’t understand very well how insecticides can prevent malaria and therefore they do not accept it fully, as it is a new thing in this area”. The informant also indicated that they thought they could control malaria by making sure people get more health education on the transmission and prevention of the disease. A similar study conducted in Nigeria reported that the majority of respondents had good knowledge about malaria and the use of ordinary mosquito nets to prevent malaria, however few knew about the existence of ITN [26]. This is a different from the results of our study. All household heads, except 15% of those without bed nets, had heard of insecticides.

The majority of the household heads in the study area had attended malaria educational sessions at least once. Almost all (99%) of the households with treated bed nets had heads who said that they had attended a malaria educational session, compared to 89% of the household heads with untreated and 74% without bed nets. The differences were statistically significant and there were strong associations:

The odds that a household-head who had attended an educational session at least once would have a net was 2.84 times higher than the odds that a household head who had not attended a health education session would have a bed net.

Among households owning bed nets (untreated or treated), the odds that a household-head who had attended educational session at least once would have a treated bed net was 12.61 times higher than the odds that a household head who had not attended educational session would have a treated bed net.



The odds that a household head who had attended educational session would have a bed net and retreat it was 35.84 times higher than the odds that a head of a household who had not attended educational session will have a net and retreat it.

Several heads of households mentioned Kihansi Public Health Project as the main provider of health education (more than 94% of the interviewed household heads). For sustainability reasons the project should probably consider to train CORPs more about malaria and about communication skills and effective IEC strategies. Many heads of households said they got malaria information also from other sources, but the proportion varied from 22% in the group of household without nets, via 45% in households with untreated nets to 83% in the group of households with treated bed nets. The interviewees were also asked about other sources of malaria information than face-to-face health education. A higher proportion of the household heads with treated bed nets (54%) than with untreated bed nets (47%) and without bed nets (32%) mentioned radio as another source of information. Thirty percent of the heads of households with treated bed nets said they got information from leaflets compared to a smaller but equal proportion of those with untreated bed nets and without bed nets (18%). The radio therefore seems to be an important source of information when it comes to the use and re-treatment of bed nets. The same is true for reading materials, although they will not be of much use for illiterate people.

Literacy and schooling influence the level of knowledge as well as the use and re-treatment of bed nets. Household with treated bed nets had a higher proportion of literate heads than households with untreated and no bed nets, and they had also spent more years in school. Persons who are literate have access to different reading materials on malaria, like books, leaflets, pamphlets, postal messages, and

newspapers. In order to give opportunities to the illiterate heads of households to get knowledge on malaria and re-impregnation, it is important to consider their situation when health education programs are designed. - Pictures, illustrations, public meetings and infotainment are communication approaches that can be used to reach them. In addition to this, household with heads with high education are more likely to be employed and get good paying jobs which again contribute to good economical status and a higher likelihood of using and re-treating bed nets.

### **Preference of colour of bed nets**

Green and white coloured bed nets were the only ones available in the study villages. Interestingly, a higher proportion of respondents without bed nets (22%) said they preferred nets of blue colour than those with untreated (9%) and treated nets (5%). The differences were significant. The lack of blue nets in the study area seems to have influenced the purchasing pattern of bed nets. More than half of respondents in all of the three groups said that they preferred green colour because it doesn't get dirty easily. This was also reported by other studies [21], [16], [14]. It seems clear that people have different preferences when it comes to making decisions about the purchasing of health-related products. It is important that social marketing approaches acknowledge this fact. Simple market research should therefore be conducted before the project is launched.

### **Perception of malaria**

Malaria seemed to be perceived as one of the major health problems in the study area. All heads of households, except 4% of those without bed nets, said that they sometimes see mosquitoes in their hamlets. Moreover, all interviewed heads of

households, except 5% of those without bed nets, said that some people get malaria in their hamlets. This awareness is important, because no one could be expected to use a bed net if he or she doesn't perceive that malaria is a problem in the local setting. Many of the informants interviewed as part of the qualitative part of this study said that malaria-related problems may lead to inability to pursue normal activities for more than a week, and that this could be contributing to poverty. The general impression, therefore, is that people perceive malaria as an important health threat in these villages and that they consider the seriousness and complications of this disease as a cause of low economical status of their villages. Surprisingly, when asked to give reasons for not treating their bed nets, 37% of the heads of households with untreated bed nets said that they don't treat their bed nets because there were not many mosquitoes. May be more people would have used treated bed nets if there would have been a higher density of mosquitoes at the time of the study. A study conducted in Tanzania, has shown that people do not use their nets and store them (in packs) waiting for high-density mosquito periods [17]. Our study was conducted during the dry season when there are low mosquito densities. However during the dry season there is an increased temperature and this is associated with an increased frequency of mosquito feeding. The gonotrophic cycle (interval between blood meals) shortens with increases in temperature, and the effects of a small temperature increase from  $19^{\circ}\text{C}$  to  $21^{\circ}\text{C}$  shortens the gonotrophic cycle from 4 to 3 days and increases the vectorial capacity of the mosquito [28]. This is one of the reasons why there is a need for people to continue to use bed nets even if the number of mosquitoes has gone down.

Studies that have been done on effectiveness and efficacy of insecticides have proven that insecticide treated bed nets reduce transmission, morbidity and mortality rates in

many high endemic malaria countries [6], [7]. The present study has confirmed this. A higher proportion of heads of households without bed nets (40%) had a history of malaria-related symptoms during the past 4 weeks than those with untreated (29%) and treated bed nets (1.94%). The same trend was evident for the other household members. A higher proportion of the households without bed nets (41%) reported that they had other members with malaria-related symptoms during the past 4 weeks than those with untreated (34%) and treated (7%) bed nets. These results indicate that households with treated bed nets were more protected against mosquito bites and malaria infection compared to households with untreated bed nets, and much more protected compared to households without bed nets at all. The differences between the groups were statistically significant. The subjective reports of malaria symptoms were supported by malaria testing in the laboratory. A higher proportion of household heads without bed nets had malaria parasite in their blood (12.63%) at the day of the interview than household heads with untreated (8.42%) and treated (3.92%) bed nets. This study has not investigated the effectiveness of other malaria-preventive methods like use of indoor residue house-spraying (IRS) which was suggested in a recent study conducted in Kenyan highland that it might be both more effective and cheaper than ITNs in communities subjected to low, seasonal risks of infection [29]. These results seem to differ with those shown that ITNs are more cost effective [10], [11], [12]. This might be due to the fact that these studies were conducted in different malaria endemic conditions or other factors like housing standards, which may influence the residual effect of sprayed insecticides and its outcome in the transmission of malaria.

## **Perception on the effectiveness of insecticides**

Almost all of the interviewed heads of households in the study area seemed to believe that insecticides for treating bed nets are effective. Only a small proportion (4%) of the household heads without bed nets thought that insecticides were not helpful in preventing malaria. However, the degree to which they believe in insecticides differed from one group to another. All heads of households with treated bed nets felt that insecticides help ‘very much’ in the prevention of malaria. The corresponding percentages were relatively high, although significantly lower, among household heads with untreated nets (95%) and without bed nets (83%). Thirteen percent of the households without bed nets and 4% with untreated bed nets had heads said that insecticides help to a ‘certain extent’. People who do not perceive insecticides as effective would of course not be willing to buy them, and even small differences in belief seems to influence the use and re-treatment of bed nets. The general positive perception of bed nets in the study area was also illustrated by our qualitative enquiry, in which almost half of the informants said that the consequence of re-treatment of bed nets with insecticide is good health of the people because the chemical repels mosquitoes. A 50 years’ old said that people who treat their bed nets in his village do not get mosquito bites because “dawa ya mbu ina harufu inayo fukuza mbu” (the insecticide has a smell which repels mosquitoes). A few informants said that people who re-treat their bed nets with insecticides get comfortable sleep because mosquitoes die and the chemical kills other insects like bed bugs and cockroaches. A similar study also reported this interesting finding [21]. This gives an impression that in addition to prevention of malaria, people appreciate other benefits of impregnated bed nets. On one side this may help in making people buy insecticide treated bed nets. On the other hand it is a question whether health educators should put too much emphasis on such

additional benefits in their communication as this could distort their main message: ITNs are designed to prevent mosquito bites and malaria.

### **Peoples perception on the side effects of insecticides**

A high proportion of the interviewed heads of households believed that insecticides for treating bed nets were safe. Almost all (99%) household heads with treated bed nets thought that insecticides have no side effects compared to 85% of household heads with untreated bed nets and 76% of household heads without bed nets. The odds ratios showed a strong association between the perception of side effects and the use and re-treatment of bed nets:

- The odds that a household head who perceive that insecticide is safe will have an (untreated) net is 1.8 times higher than the odds that a household head who doesn't believe that insecticide is safe will have an (untreated) bed net.
- Among those with bed nets (treated or not) the odds that a household head who perceive that insecticide is safe would treat his bed net is 18.0 times higher than the odds that a household head who don't perceive that insecticide is safe would treat his bed net.
- The odds that a household head who believe that insecticide is safe will have a treated bed net is 32.2 times higher than the odds that a head of a household who don't believe that insecticide is safe will have a treated bed net.

These results were supported by responses from informants of the qualitative part of this study. Almost half of the informants explained that some people in their villages believe that insecticides have side effects. It is obvious that if people perceive that

insecticides are having side effects, they are less likely to use them. One of the respondents even believed that insecticides could cause cancer! For the successfulness of ITN programs, it seems clear that there is a strong need of addressing the safety issues of the insecticides, as this seems to be one of the most important factors.

### **Perception on the process of re-impregnation bed nets with insecticides**

Perception of the process of re-treating bed nets seems to have an influence on the actual re-treatment of nets. A high proportion in all three study-groups, thought that re-treatment of bed nets does not take much time and is not difficult. However, a relatively high proportion (17%) of households with untreated bed nets had heads who said that they sometimes forget to treat their bed nets, compared to 3% of the households with treated bed nets. It might be that household heads with untreated bed nets forget to treat their bed nets because they have a low level knowledge (you don't remember something if you don't know about it), give priority to other pressing needs and because they live far from the nearest sources of insecticides. Remembering something requires a willingness to do it. Willingness as well is influenced by several factors including economy, knowledge and availability.

The process of re-treating bed nets involves the use of a container for dipping of the bed net. All of the households with treated bed nets had a container that could be used for re-treatment, compared to 85% of the households with untreated bed nets and 52% of those without bed nets. The observation exercise conducted after each interview seemed to confirm this information. Buying a container costs some money depending on size and type. However there is no need to use special containers for treating bed nets. It might be that households with untreated bed nets and without nets were afraid to use some of their containers for dipping because they believed that the insecticide

might be mixed with other items and harm them. A 27 years' old woman explained that some people believe that insecticide is toxic to human beings as they were told that they should put on gloves and bury them after treating their bed nets.

### **Availability of insecticides**

There were considerable differences between the three groups regarding the availability of insecticides. Almost all (99%) households with treated bed nets had heads who said that insecticides were available in their village, as compared to 78% of households with untreated nets and 63% of households without bed nets. A higher proportion of the households without bed nets (22%) said they either did not know or could not provide any information about the availability of insecticides in their villages than household with untreated bed nets (13%) and treated bed nets (0%). This study has also shown that households without bed nets lived further away from their nearest sources of insecticides (the average travel time was 32.41 minutes), than households with untreated bed nets (19.19 minutes) and treated bed nets (12.43 minutes). Country wide, insecticides seem to be a new item, which has not reached most of rural areas, as the situation used to be in the villages under study. Most of areas where insecticides are readily available have or have had special ITN projects [21] [30]. It is important to consider how to maintain the supply of insecticides in these villages when the projects are over. Even if you have money, knowledge and good perceptions you will of course not be able to re-treat your net if the insecticides are not available. Following this, in all ITN programs, sustainable sources of insecticides should be emphasised. There should be a good and continuous flow of nets and insecticides from the manufacturer to the target population.



A high proportion of household heads with treated and untreated bed nets said that they bought their nets through the Kihansi Public Health Project (MUAJAKI). Only 2% of those with treated bed nets, and 1% with untreated nets, mentioned that they bought their nets from a shop or kiosk in the village. It seems clear that MUAJAKI was the main source of bed nets in these villages. Experience from other projects show that the use of several different channels of bed nets and insecticides contributes to a more reliable availability of ITNs products [14]. Other persons in the villages that might be involved in the sales of ITNs products could be existing-shops, village health workers, other CORPs, schools, hamlet leaders and anyone who is interested and accepted by the community. This might create a possibility of reaching even those who live far from the current sources of insecticides. However to be a sales person of these products, one should have some amount of money as a capital and also knowledge on the treatment process in order to educate customers.

### **Related factors**

It seems likely that some of the identified factors are related in some ways. People with a high level of education are most likely to have paid jobs, which make them to have good economy and be able to buy nets and insecticides. Literacy is necessary in order to be able to read materials about malaria and ITNs, and therefore helps in acquiring knowledge about malaria and insecticide treated bed nets. A good household economy makes it more likely that someone will go school, be accessible to reading materials and therefore be in a position to have good knowledge on malaria and ITNs. Having good knowledge makes one to understand well how the insecticide could prevent malaria and therefore to have positive perception on the efficacy,

effectiveness and safety of the insecticides which influence the use and re-treatment of bed nets.

### **Comments to the study**

The study design seemed to have been appropriate for the topic. A representative sample was randomly drawn from the respective study groups, and this has made it possible to draw general conclusions about the three strata of households in the study area. Privacy was maintained during data collection, and data were kept confidentially and carefully analysed. The findings of this study are consistent with similar studies.

## CONCLUSIONS

Following the findings of the present study we conclude that;

The level of knowledge about malaria, bed nets and re-impregnation of bed nets is associated with the use and re-treatment of bed nets.

Availability of, and accessibility to, insecticides is associated with the use and re-treatment of bed nets.

The combination of high costs of bed nets and insecticides and low purchasing power are associated with lower use and re-treatment of bed nets.

Myths about possible side effects of insecticides are associated with a lower use and re-treatment of bed nets.

Misconceptions about the effectiveness of insecticide treated bed nets are associated with lower rates of use and re-treatment of bed nets.

Perceptions about the re-treatment process of bed nets are associated with the rates of use and re-treatment of bed nets.

Literacy is associated with the rate of use and re-treatment of bed nets

The level of educational is associated with the rate of use and re-treatment of bed nets

Peoples' preference of unavailable colours of bed nets is associated with the use and re-treatment of bed nets.

## RECOMMENDATIONS

Although behaviour change may take time, especially among older people, still health education through different adult learning methods can help them to change to healthier behaviour. We therefore recommend that;

Behaviour Change Communication (BCC) should be maintained for a long time in the study area because behaviour change takes time. The BCC activities should be designed in such a way that they would reach the entire population in the area, but special efforts should also be considered in order to reach the less beneficial groups like those with poor socio-economic status, those who are illiterate, and those without much schooling. It is in these groups that we currently find the majority of households without ITNs.

Although the awareness and knowledge in the study area was relatively high, still health education and other information, education and communication (IEC) approaches should continue for some years in order to maintain the positive development of the ITN program.

Innovative ways of reaching poor households should be explored. This can be done by organising educational sessions in small groups of households, or by recruiting peer educators specifically from each of the three study groups: households with treated bed nets, households with untreated bed nets and households without bed nets at all. The existing health facilities in the villages could also be involved. Any patient who comes for malaria treatment should be asked politely if has used a net or insecticides, and if not he should be offered a chance to buy the products there and then. The

products should be sold in highly subsidised price to the affordability of low economy families.

Special messages should be disseminated about specific aspects like the importance of using nets throughout the year as even a low numbers of mosquitoes in the dry season represent a risk of getting serious malaria [28]. Other messages should focus on the importance of correct hanging of bed nets and misconception on the efficacy, effectiveness and safety of insecticide.

In order to make as many people as possible able to afford the cost of insecticides, we recommended that;

Income-generating projects should be considered in these villages since the purchasing power is so low. This could be achieved in collaboration between the community development, agriculture, education and other departments.

Price reduction and subsidisation on bed nets and insecticides should be considered. This would result in a certain income loss for the government, but the advantages to the country would be great, as malaria is a widespread and countrywide problem. Especially in areas where malaria has recently been introduced, the level of subsidisation should be high enough to make nets and insecticides easily affordable even for households with a very low socio-economic status.

The products should however not be provided free, as this tends to reduce the perceived value of the products. Also, the supply sustainability in free programs is often a problem.

A social marketing approach should be used in stead. This type of approach is most suitable for addressing issues of quality of products, price, awareness and knowledge, availability and sustainability.

These recommendations need a multisectoral approach with big commitment from the communities themselves, local authorities, government and donor agencies. This joint mission is needed because the implementation of ITN programs involves some steps beyond the reach of the local communities, i.e. politics and legal issues related to manufacturing and delivering of products to consumers and exemptions and subsidisation.

As economy and cost of insecticide treated bed nets (ITNs) products were found to be among the major factors influencing the use of ITNs, it is recommended that further studies on the willingness and ability to pay for ITNs products should be conducted.

It was shown that some people preferred certain colours, sizes and types of bed nets that are not available in the study area. It is recommended that different types of colours, sizes and types of bed nets be made available to satisfy the preferences of the customers.

To maintain the reliable availability of bed nets and insecticides, we recommend that several different persons be involved in the sales of bed nets and insecticides in the villages. This might include sales person selected by villagers according to their interest and income, CORPs, health units and existing shops [14]

As the Kihansi Public Health Project was found to be the main provider of health education, it is recommended that CORPs should be trained more on the subject and

on communication skills, so that they continue to provide health education when the MUAJAKI winds down some time in the future.

As there are many factors influencing the use and re-treatment and they might be related in some ways, the designing and implementation of ITN programs, should consider all factors.

As previous studies have proven that ITNs were cost effective in malaria prevention and a recent study conducted in Kenya, has suggested that indoor residual house-spraying may be more cost effective than ITNs [29], it is recommended that a comparative advantage of these two methods should be re-visited.

As malaria is a newly introduced disease in the study villages, and taking into consideration that people in the highland are at high risk of getting serious and epidemic malaria, we recommend that monitoring studies should be done for some years in order to assess the development of the situation.

Once malaria is found to be introduced in a new area, the communities themselves, the government and donor agencies should start measures immediately before the emerging of serious malaria and epidemics as it was reported in Kenya [31] and Zimbabwe [32]

Finally we recommend that any big construction project in developing countries should include a health impact assessment and mitigation program like the one which was implemented at the Lower Kihansi Hydropower project in Tanzania.

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# APPENDIX

## Appendix 1: Ethical clearance from Ministry of Health

FROM: K MOEN & T DANIELSEN +47 22524291 PAGE: 02

THE UNITED REPUBLIC OF TANZANIA  
MINISTRY OF HEALTH

Telegrams: "AFYA",  
DAR ES SALAAM  
Telephone: 2120261 -7  
Fax: (255) -22 - 2139951/110996/138283  
(All letters should be addressed to  
the Permanent Secretary)

P.O. Box 9083,  
DAR ES SALAAM

Ref. No. HED/52/91/VOL.V/76. 11<sup>th</sup> July, 2001

✓ The RMO - IRINGA  
The DMO - MUFINDI DISTRICT

RE: MOH PERMIT FOR OMARI CHAMBO TO CARRY OUT RESEARCH IN  
MALARIA CONTROL: FACTORS INFLUENCING USE OF INSECTICIDE  
TREATED BED NETS IN THE SOUTHERN HIGHLANDS:

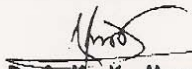
Please refer to the above captioned subject.

Mr Omari Chambo is a student at the University of Oslo, Norway pursuing a  
MPH course in International Community Health. He is required to carry out a  
study as part of fulfilling his course's requirements. He will be looking into  
factors influencing the use of Insecticide treated nets in Mufindi district.

He submitted his Research protocol to the Ministry of Health and a letter  
requesting permission to do so. Having reviewed the proposal, the Ministry finds  
the study to be addressing a priority health problem and has therefore granted  
Mr Chambo permission to carry out the study. He is, however, required to  
submit a copy of the study findings to this Ministry at the end of his course.

By copy of this letter, I am requesting your office to give him all necessary  
assistance needed during his fieldwork in your region/district. This may include  
letters of introduction to different local authorities.

Yours sincerely

  
Dr L.M.K. Munyetti  
for PERMANENT SECRETARY

c.c: Omari Chambo - for information

## Appendix 2: Protocol approval from Norwegian ethical committee

UNIVERSITETET I BERGEN

*Det medisinske fakultet*  
Harald Hårfagresgt. 1, 5020 BERGEN  
Tlf: 55 58 20 84/86  
Fax: 55 58 96 82  
E-post: Rek-3@iuh.no



UNIVERSITY OF BERGEN

*Faculty of Medicine*  
Harald Hårfagresgt. 1, N-5020 BERGEN  
Ph: +47 55 58 20 84/86  
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E-mail: Rek-3@iuh.no

<http://www.etikkom.no/NEM/REK/rek.htm>

*Regional komité for  
medisinsk forskningsetikk  
Helseregion Vest (REK III)*

Bergen, 26.06.01

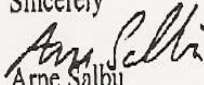
To whom it may concern

**Confirmation (REK III number. 063.01)**

We hereby confirm that the research protokoll *Preventive actions against malaria – a study of factors influencing reimpregnation of bed nests in highland villages of Tanzania* has been evaluated by The Regional Committee for Medical Research Ethics in Western Norway (REK III).

The protocol is now approved.

Sincerely

  
Arne Salbu  
Secretary

## Appendix 3: Informed consent information sheet

A survey is currently being carried out in your village. A random selection of persons have been selected to take part by giving their answers to questions about thoughts, opinions, knowledge and attitudes that could be of importance to the health situation in the village. You are one of the persons that have been randomly selected to take part in the survey, and you are hereby invited to become a participant. You were selected randomly from your village chairman's list of all the inhabitants in your village. It is optional to take part, and you will not be paid for your participation. The survey is conducted with approval from the Ministry of Health, District Medical Officer and the village government, and in collaboration with the MUAJAKI project. Omari Chambo, who used to be the resident project co-ordinator of MUAJAKI, co-ordinates the fieldwork for the study. If you choose to take part, you will be asked a series of questions about your household and your views about things like malaria and malaria prevention. The interview may take up to one hour to complete. Your answers will be written down by an interviewer and later used for statistical analysis. All the information you provide will be handled as confidential, and your individual answers will not be known to anyone apart from the interviewer and the co-ordinator of this survey. Your individual answers will under no circumstance be made available for the authorities locally, regionally or nationally. Instead, your answers will be held together with the answers from 300 other persons. A summary of what you have collectively expressed will be presented in a report that will be available to anyone with an interest for health issues locally, nationally and internationally. The goal is to use the result and knowledge from this survey in order to propose actions that can contribute to a better health status in local communities of this type in Tanzania and abroad. As part of the survey, a blood sample will be taken from you in order to find out whether you have malaria. The blood will be obtained through a prick from a small needle in one of your fingertips. The procedure is the same that doctors normally use in the hospitals when they want to check whether someone has malaria. A small drop of blood will be taken onto a small piece of glass and examined for malaria in a microscope. If you were to have malaria, you will be notified and you will be offered malaria treatment without any cost for you. The blood test will not be used for anything else than the malaria test. It is entirely optional to take part in this survey. Even if you choose to take part now, you may change your mind later, also after the interview is over and the blood test has been taken. If you choose to withdraw for whatever reason, you even have a right to demand that your answers and malaria test results be deleted. If you have any questions, now or later, you may contact any of the following persons:

Your interviewer: [name]

Your hamlet chairman: [name]

Your village chairman: [name]

The MUAJAKI project co-ordinator: Dr. Christopher Manumbu (Mgugwe)

The survey field co-ordinator: Mr. Omari Chambo (Mgugwe)

### **Consent**

I have received information, both in writing and verbally, and I am willing to participate in the study

Name: \_\_\_\_\_

Date: \_\_\_\_\_ / \_\_\_\_\_ 2001

Signature: \_\_\_\_\_

## Appendix 4: Questionnaire

### Administrative and identification information

1. Questionnaire number  
|\_|\_|\_|\_|
2. Date of interview (DD..) |\_|\_|\_| /  
MM |\_|\_|\_| / YYYY  
|\_|\_|\_|\_|
3. Interviewer, ID. number |\_|\_|\_|
4. Village ID number |\_|\_|
5. Hamlet ID number |\_|\_|\_|
6. Sample number |\_|\_|. |\_|\_|\_|\_|
7. Census number  
|\_|\_|\_|\_|\_|\_|\_|\_|\_|

### Interviewee information

8. First name of interviewee,  
\_\_\_\_\_
  9. Last name of interviewee,  
\_\_\_\_\_
  10. Sex [1] Male [2]Female  
[9]UNK/NR
  11. How old are you? Years |\_|\_|\_|
  12. Can you write and read Swahili?  
[1]Yes [2]No  
[9]UNK/NR
  13. Have you gone to school? [1]Yes  
[2]No [9]UNK/NR
- What is your highest level reached?
14. Primary education |\_|\_|\_|
  15. Secondary education |\_|\_|\_|
  16. Higher education |\_|\_|\_|
  17. Adult education |\_|\_|\_|

18. Vocational college |\_|\_|\_|
19. Total number of years in school  
|\_|\_|\_|
20. Have you been employed for past  
12 months [1]Yes [2]No  
[9]UNK/NR
21. Have you been a peasant for past  
12 months [1]Yes [2]No  
[9]UNK/NR
22. Have you been a businessman for  
past 12 months [1]Yes [2]No  
[9]UNK/NR

### Household information

23. How many people live in this  
household? |\_|\_|\_|
24. How many contribute to the  
income of this household?  
|\_|\_|\_|
25. How much income does this  
household get per year in cash?  
Tshs, |\_|\_|\_|\_|\_|\_|\_|\_|\_|
26. How many acres of arable land do  
you have in this household?  
|\_|\_|\_|\_|. |\_|\_|\_|
27. How many chickens do you keep  
in this household? |\_|\_|\_|\_|
28. Do you have a radio in this  
household? [1]Yes [2]No  
[9]UNK/NR

29. How many people sleep in beds in this household?
30. How many people sleep in beds with a mattress in this household?
31. How many people sleep on mats in this household?

#### Bed nets

32. Do you have bed nets in this household? [1]Yes [2]No [9]UNK/NR

If no,

33. Please tell me the reason, \_\_\_\_\_,  
code no.

If yes,

34. How many bed nets do you have in this household?
35. How many people sleep under bed nets in this household?
36. If not all persons sleep under nets, please tell me the reason, \_\_\_\_\_,  
code no.
37. Did you sleep under a bed net last night? [1]Yes [2]No [9]UNK/NR
- If no,
38. Give reason \_\_\_\_\_,  
code no.

39. Do you use any other methods of malaria prevention? [1]Yes [2]No [9]UNK/NR

If yes,

40. Mention used methods, \_\_\_\_\_,  
code no.

#### The last bed net purchased by the household

41. When was your last bed net purchased? DD, MM, YYYY
42. From whom was it purchased? \_\_\_\_\_,  
code no.
43. How much did you pay for it? Tshs

#### Opinion on bed nets

44. Which colour of a net do you prefer? \_\_\_\_\_,  
code no.
45. Please tell me the reason \_\_\_\_\_,  
code no.
46. Which size of net do you prefer [1] Small (3x6ft) [2] Medium (4½x6ft) [3] Big 6x6ft [9]UNK/NR
47. Please tell me the reason \_\_\_\_\_,  
code no.

48. What type of net do you prefer [1]  
Conical [2] Rectangular  
[9]UNK/NR

49. Please tell me the reason  
\_\_\_\_\_,  
code no. |\_\_|\_\_|

### **Malaria**

50. Do you sometimes see mosquitoes  
in this hamlet? [1]Yes [2]No  
[9]UNK/NR

51. Do you agree that one of the  
symptoms of malaria is fever and  
headache [1]Yes [2]No  
[9]UNK/NR

52. Do you agree that one of the  
symptoms of malaria is ear ache,  
colds and cough [1]Yes  
[2]No [9]UNK/NR

53. Do you agree that one of the  
symptoms of malaria is fever,  
diarrhoea and vomiting in children  
[1]Yes [2]No  
[9]UNK/NR

54. Are there some people getting  
malaria in this hamlet? [1]Yes  
[2]No [9]UNK/NR

55. Have you had any malaria related  
symptoms in the past 4 weeks?  
[1]Yes [2]No  
[9]UNK/NR

56. Have any other household member  
had malaria related symptoms in

the past 4 weeks? [1]Yes  
[2]No [9]UNK/NR

57. Do you think malaria can cause  
death? [1]Yes [2]No  
[9]UNK/NR

58. Do you think malaria can cause  
convulsion? [1]Yes [2]No  
[9]UNK/NR

59. Do you think malaria can cause  
cancer? [1]Yes [2]No  
[9]UNK/NR

60. Do you think malaria can cause  
anaemia? [1]Yes [2]No  
[9]UNK/NR

61. Do you think malaria can cause  
abortion? [1]Yes [2]No  
[9]UNK/NR

### **Insecticides**

62. Have you ever heard about  
insecticides for treating nets?  
[1]Yes [2]No  
[9]UNK/NR

If yes,

63. What way did you hear about it?  
\_\_\_\_\_,  
code no. |\_\_|\_\_|

64. How many nets have ever been  
treated with insecticide in this  
household? |\_\_|\_\_|

65. If there is no even a single net,  
which has ever been treated, please  
give reason,

- \_\_\_\_\_,  
code no. |\_\_|\_\_|
66. If there is at least one net, which  
has ever been treated, please give  
reason  
\_\_\_\_\_,  
code no. |\_\_|\_\_|
67. How many nets have been treated  
with insecticide in the last three  
months? |\_\_|\_\_|
68. Do you think use of insecticide  
treated bed net helps to prevent  
malaria? [1]Yes [2]No  
[9]UNK/NR
69. If yes, at what extent does it help?  
[1]Very much [2] A certain  
extent [3]Very little  
[9]UNK/NR
70. Do you think insecticides for  
treating nets have side effects?  
[1]Yes [2]No  
[9]UNK/NR
- If yes,  
71. Please mention the effect,  
\_\_\_\_\_,  
code no. |\_\_|\_\_|
72. Are the insecticides for treating  
nets always available in this  
village? [1]Yes [2]No  
[9]UNK/NR
73. How much time do you take to  
reach the nearest source of  
insecticides? minutes |\_\_|\_\_|

74. Do you know how many nets can  
be treated by one insecticide (“Zuia  
mbu” sachet/ “Ngao tablet brand  
name”)? |\_\_|\_\_|
75. Do you have a container, which  
could be used for treating a net in  
this household? [1]Yes [2]No  
[9]UNK/NR
76. Do you think insecticide for  
treating bed nets is expensive?  
[1]Yes [2]No  
[9]UNK/NR
- If Yes,  
77. How much do you think it should  
fairly be sold?  
Tshs|\_\_|\_\_|\_\_|\_\_|
78. Do you think treating a bed net  
takes much time? [1]Yes  
[2]No [9]UNK/NR
79. Do you think treating a bed net is  
difficult? [1]Yes [2]No  
[9]UNK/NR
80. Do you often forget to treat your  
bed net? [1]Yes [2]No  
[9]UNK/NR

**The last re-impregnation of a bed  
net in this household**

81. When was the last time a bed net  
was treated in this household? DD  
|\_\_|\_\_, MM|\_\_|\_\_,  
YYYY|\_\_|\_\_|\_\_|



82. Who treated it?  
\_\_\_\_\_,  
code no. |\_\_|\_\_|

83. From whom did you buy  
insecticide for treating your net last  
time? \_\_\_\_\_,  
code no. |\_\_|\_\_|

84. How much did you pay for the  
insecticide? Tshs |\_\_|\_\_|\_\_|\_\_|

### **Educational sessions**

85. Have you ever attended a malaria  
education session? [1]Yes  
[2]No [9]UNK/NR

If yes,

86. How many sessions this year?  
|\_\_|\_\_|

87. Who provided the last health  
education session?  
\_\_\_\_\_, code  
no. |\_\_|\_\_|

88. Have you ever got any information  
about malaria from any other  
source? [1]Yes [2]No  
[9]UNK/NR

If yes,

89. Which source?  
\_\_\_\_\_,  
code no. |\_\_|\_\_|

### **Agree or Disagree questions**

#### **Knowledge on malaria transmission**

90. Some mosquitoes transmit malaria  
[1] Agree [2]Disagree  
[9]UNK/NR

91. All mosquitoes transmit malaria  
[1] Agree [2]Disagree  
[9]UNK/NR

92. Malaria mosquitoes bite at night  
[1] Agree [2]Disagree  
[9]UNK/NR

93. Mosquitoes cannot transmit  
malaria after sunset [1] Agree  
[2]Disagree [9]UNK/NR

94. Malaria can be transmitted from  
infected pregnant woman to fetus  
[1] Agree [2]Disagree  
[9]UNK/NR

95. Malaria can be transmitted by  
drinking contaminated water [1]  
Agree [2]Disagree  
[9]UNK/NR

96. Stagnant water can be a source of  
mosquito breeding [1] Agree  
[2]Disagree [9]UNK/NR

97. Sum of correct answers |\_\_|

98. Sum of incorrect answers |\_\_|

#### **Knowledge on malaria prevention**

99. Sleeping under insecticide treated  
bed net can help to prevent  
mosquito bite [1] Agree  
[2]Disagree [9]UNK/NR

100. Drinking boiled water can help to  
prevent malaria [1] Agree  
[2]Disagree [9]UNK/NR

101. Use of insecticide treated bed nets  
can help to prevent malaria

- [1]Agree [2]Disagree  
[9]UNK/NR
102. Use of insect repellents can help to prevent malaria [1] Agree  
[2]Disagree [9]UNK/NR
103. Impregnated bed net can still help to prevent malaria even if is having holes [1]Agree  
[2]Disagree [9]UNK/NR
104. Putting on long sleeved cloths at night can help to prevent malaria [1] Agree [2]Disagree  
[9]UNK/NR
105. Screened house windows can help to prevent malaria [1] Agree  
[2]Disagree [9]UNK/NR
106. Burning of mosquito coils can help to prevent malaria, [1] Agree  
[2]Disagree [9]UNK/NR
107. Sum of correct answers
108. Sum of incorrect answers

#### **Knowledge on re-impregnation of bed nets**

109. Any amount of water can be used in treating a bed net with insecticide [1] Agree  
[2]Disagree [9]UNK/NR
110. Ideally treatment of bed nets (zuia mbu/ngao brand names) should be done after every 6 months  
[1]Agree [2]Disagree  
[9]UNK/NR

111. Ideally treatment of bed nets (zuia mbu/ngao brand names) should be done after every 3 months  
[1]Agree [2]Disagree  
[9]UNK/NR
112. Washing of a treated net reduces the effectiveness of the insecticide  
[1] Agree [2]Disagree  
[9]UNK/NR
113. Drying a net under the sun after treatment affect the efficacy of the insecticide [1]Agree  
[2]Disagree [9]UNK/NR
114. Sum of correct answers
115. Sum of incorrect answers

#### **Summary for household members using insecticide treated bed nets in age and sex**

116. How many males live in this household?
117. How many males sleep under bed nets in this household?
118. How many males sleep under insecticide treated bed nets in this household?
119. How many females live in this household?
120. How many females sleep under bed nets in this household?
121. How many females sleep under insecticide treated bed nets in this household?

122. How many children under-five  
years live in this household?

|\_|\_|

123. How many children under-five  
years sleep under bed nets?

|\_|\_|

124. How many children under-five  
years sleep under insecticide  
treated bed nets? |\_|\_|

**To be filled by interviewer  
(Parasitemia)**

125. Was blood slide taken? [1]Yes

[2]No [9]UNK/NR

If no,

126. Give reason

\_\_\_\_\_

code no. |\_|\_|

If yes,

127. What is the slide no?

|\_|\_|\_|

128. Malaria slide results; [1]Positive

[2]Negative [9]UNK/NR

If positive

129. Was the treatment given to the

subject? [1]Yes [2]No

[9]UNK/NR

If no,

130. Give reason,

\_\_\_\_\_, code

no. |\_|\_|

## Appendix 5: Observation check list (for interviewer use)

131. Materials used for roofing a house

[1]Corrugated iron sheets

[2]Thatched, [9]UNK/NR

132. Presence of radio [1]Yes

[2]No [9]UNK/NR

133. Number of beds present? |\_|\_|

134. Number of mattresses present

|\_|\_|

135. Number of mats present |\_|\_|

136. Number of bed nets present

|\_|\_|

137. A net hung correctly above the

bed or mat? [1]Yes [2]No

[9]UNK/NR

138. Presence of container that can be

used for treating a bed net? [1]Yes

[2]No [9]UNK/NR

## Appendix 6: Interview guide for qualitative approach

This guide consists of questions on knowledge, attitude, perception and practice of importance for malaria prevention and re-treatment of insecticide treated bed nets.

### **Socio-demographic information**

1. Date of interview (DD.MM.YY) \_\_\_\_| / \_\_\_\_ / \_\_\_\_
2. Village \_\_\_\_\_
3. Name of interviewee, First: \_\_\_\_\_ Last: \_\_\_\_\_
4. Sex \_\_\_\_\_
5. What is your educational background?
6. Are you married?
7. Do you have children?
8. How many people live in your household?
9. What do you usually do for your living?

### **Knowledge, Attitude, Perception and Practice.**

*I have a lot to learn from what you think about these issues;*

10. What are the consequences of major health related problems in this village?
11. What are the consequences of malaria in this village?
12. Can you tell me why people get malaria in this village?
13. What normally people do to prevent malaria in this village?

*I am interested in learning more about how you see and deal with these things in your daily lives;*

14. Can you tell me something about the challenges of preventing malaria in this village?
15. What are the consequences of regular re-treatment of bed nets with insecticide?
16. Can you tell me as to why many people not treat their bed nets with insecticides in this village?
17. Can you tell me why does malaria problem never get finished in this village?
18. Can you tell me something about how we could finish the malaria problem soon in this village?